C. L. Babcock

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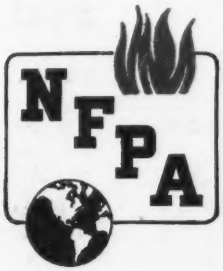
of the

National Fire Protection Association

INTERNATIONAL



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Vol. 51 No. 1 July 1957

Quarterly

The Standard Technical Journal of Fire Protection for More Than Forty Years

The NFPA is a non-profit technical and educational organization devoted to the reduction of loss of life and property by fire with a total membership of 17,000. The *Quarterly* is one of the publications regularly provided to members. Other membership publications include *Fire News*, *Advance Reports* to the Annual Meeting, a *Year Book*, and many leaflets, pamphlets and posters issued throughout the year on fire prevention and control. Six volumes of the National Fire Codes are available on an annual subscription basis, one volume free and others at reduced membership rates. For full details on available material ask for the free "List of NFPA Publications."

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NATIONAL FIRE PROTECTION ASSOCIATION

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Failure to provide a door at the top of the basement stairs was the major factor responsible for the deaths of five children in this Columbus, Ohio home on May 8. **See article starting on page 17.** *Wide World Photo*

Editorials

A Life-Saving Crusade

IF they will do it, the frequency of fires will go down just as fire goes out when you put water on it. Jay W. Stevens, Chairman of the Fire Prevention Committee of the International Association of Fire Chiefs urged Fire Chiefs by these words to carry on with increasing vigour the IAFC's home inspection program of fire prevention. Receiving a standing ovation from the NFPA membership at the First General Session of the 61st NFPA Annual Meeting, Mr. Stevens predicted that "the day will come when there is a ninety day inspection of everything in the city — when we really learn the value of inspection."

Drawing a parallel between a successful baseball team and an effective fire department, Mr. Stevens quoted Casey Stengel: "You can't win games unless you have pitching. You can't win games unless you have hitting." This was as if he were saying to Fire Chiefs: "You can't have half a fire department. You can't have just defense. You must have offense." He told how Los Angeles had reduced their fire frequency by 4,000 fires a year by their fire prevention inspection program, how Boston had cut fire frequency by 1,600, how Philadelphia showed a 2,700 reduction and how New York City reduced fire calls by 5,000 last year. These were just examples of what has been done and Mr. Stevens, stating that this talk was his most important speech in forty-four years, closed his remarks by saying that "God is on our side and He is asking you and me to turn the key in every door" in this life-safety crusade for fire prevention.

Japanese and Domestic Plywood

THEY smoldered for some time without being noticed and then broke out all over at once. The rapid spread was due mainly to the highly combustible interior finish. With these words Loren S. Bush, Chief Engineer of the Board of Fire Underwriters of the Pacific and NFPA Vice President, described an "epidemic" of dwelling fires in the peninsular area of the San Francisco Bay territory. Occurring in three different cities, the fires all involved "tract homes," modern ranch type speculative houses in subdivisions built by contractors. All of them had interior finish of plywood with no partitions to the ceilings, except in the sleeping areas.

Investigation disclosed that the rapid fire spread was due mainly to the plywood interior finish, abetted by the lack of partitions. All the plywood had been imported from Japan and on examination some of it showed that the adhesive that held the laminations together gave way under heat attack, leaving paper-thin sheets which added materially to the rapid spread of fire. As one fireman put it, "it doesn't catch fire, it explodes."

The Peninsula Fire Chiefs Association appointed a Committee to try to stop this epidemic and sought the assistance of local fire protection engineers, insurance organizations and building officials. The question was: how could the public have the kind of houses they wanted and yet have them safe? The answer was found in the NFPA Building Exits Code (Section 24) where this problem had been recognized by placing limitations on the use of interior finishes with flame spread ratings exceeding 200 as determined by the NFPA "Fire Tests for Fire Hazard Classification of Building Materials" (NFPA No. 255).

Palo Alto was the first city to try to get a provision into its Building Code in accordance with the NFPA recommendations. When their City Council met to consider this subject, plywood industry representatives from all over the United States flocked into Palo Alto to try to stop it. After listening to their arguments as to why there should not

be restrictions, the 23 member City Council voted unanimously for the ordinance, although they did increase the flame spread criteria from 200 to 250.

Why the U. S. plywood manufacturers took this attitude is hard to understand as data available from the Underwriters' Laboratories show that very few tests on U. S. made plywood exceed 200. In contrast, the Japanese Consul in San Francisco stated: "If these plywoods, manufactured in Japan, are found to be a potential fire hazard, this office in cooperation with the recommendations of your Committee and the manufacturers of plywood in Japan shall take all necessary steps to remedy the situation." It would be rather peculiar if the Japanese plywood people should get a good adhesive, test their plywood and have it assured that it did come under the 200 flame spread while the U. S. plywood industry was still fighting regulations for safety.

Those Wood Shingles Again! NFPA General Manager Percy Bugbee has noted with alarm the trend back to the use of wooden shingle roofs for housing developments and residential areas, particularly in southern California. He stated: "We do not want to see this situation develop to the point where a conflagration hazard of serious proportions again threatens." Speaking on this subject at the 61st NFPA Annual Meeting held in Los Angeles, he spoke directly to the people in that area urging them "to investigate this situation thoroughly and take the appropriate steps to halt this trend."

Aerosol Container Safety IT was estimated by Dr. Edmond G. Young of the Chemical Specialties Manufacturers Association that one billion aerosols have found their way into the hands of consumers in the 10 years of the industry's existence. Speaking at the 61st NFPA Annual Meeting, Dr. Young reported that in a survey conducted in 1957 among the members of the aerosol industry, no fire incidents have been reported! This is truly a remarkable record and deserving of notice.

Credit for this safety achievement belongs to the industry which realized that only if it grew safely would it grow at all. Right at the beginning, research was done to establish safe practices. Some of these safe practices have been issued in the U. S. A. as government regulations through the Interstate Commerce Commission and the United States Department of Agriculture. Others have been established as self-regulatory safety standards, issued by the CSMA.

Dr. Young noted that the use of nonflammable pressurizing liquids was the principal factor making possible this safety record. Fluorinated hydrocarbons are most commonly used; products such as "Freon" (duPont), "Genetron" (Allied Chemical and Dye) and "Isotron" (Pennsalt Chemicals). To be sure that new products have a safe level of performance, the industry developed with the Bureau of Explosives a test procedure for arriving at the flammability of aerosols. The test methods include a flame extension test (where the aerosol spray is directed into a flame), an open drum combustion test and a closed drum explosion test. Besides flammability, the industry, through the CSMA, has promulgated safe practices on pressure and toxicity and has issued uniform labelling recommendations for aerosol containers. The following warning statements appear on most metal aerosol containers:

WARNING

CONTENTS UNDER PRESSURE
DO NOT PUNCTURE

EXPOSURE TO HIGH TEMPERATURES MAY CAUSE BURSTING

KEEP AT ROOM TEMPERATURE, AWAY FROM DIRECT SUNLIGHT, RADIATORS, STOVES, HOT WATER AND OTHER HEAT

NEVER THROW CONTAINERS INTO FIRE OR INCINERATOR

Palletized Storage Fire Problems

By M. H. Nickerson, Assistant Director
Factory Mutual Laboratories

Piling heights in warehouses in excess of twenty feet have come about largely as a result of improvements in mechanical handling equipment during the past decade. Although several means are available for subdividing storage into convenient units, the most common device in use today is the wood pallet. Figures 1-A, 1-B, and 1-C show three typical wood pallets. Size and arrangement will, however, vary with individual need.

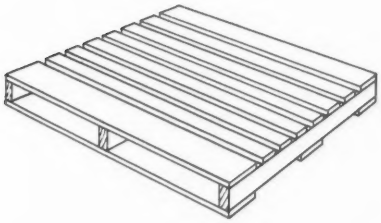


Figure 1-A. Conventional two-way entry wood pallet, double face, non-reversible.

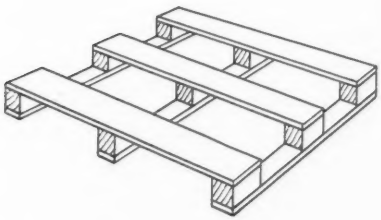


Figure 1-B. Conventional two-way entry wood pallet, double face, reversible, take-it-or-leave-it.

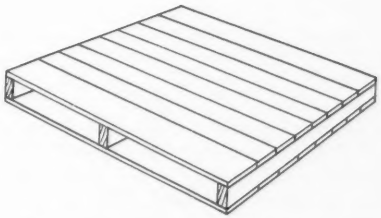


Figure 1-C. Conventional two-way entry wood pallet, double face, reversible.

Idle Pallet Storage

To the Fire Protection Engineer the hazard of idle pallet storage will be obvious. With warehouse space at a premium, the usual practice is to stack idle pallets in compact piles of considerable height. In such a pile three important factors are present to promote the rapid intensification of fire. These are:

a. Re-radiation
b. Ample access of fresh air for combustion
c. Shielding from sprinkler discharge

By "re-radiation" we mean the effect of placing two parallel, combustible surfaces at such a distance apart that the open area around the perimeter is small compared with the area of the two surfaces, but large enough to admit air for combustion and to permit products of combustion to escape. Under these conditions, heat loss by radiation from the two burning surfaces is at a low level. Thus the heat which would normally be lost through radiation is stored in the combustion zone where it increases the distillation rate. Hence the rate of combustion is accelerated.

Ample access of fresh air is present in all three styles of pallets illustrated in Figures 1-A, 1-B and 1-C, but obviously the styles shown in Figures 1-A and 1-B are more susceptible than the style shown in Figure 1-C which has solid bottom and top decks. However, in large solid piles of pallets there would be little difference once the fire had become established.

The third factor, shielding from sprinkler discharge, is one that may not be appreciated readily. It consists of the combined effect of placing a physical barrier in the path of the falling water droplets, and of opposing their fall by an intense updraft. This combination has a noticeable effect with piles of pallets only four feet high and with sprinkler operating pressure of ten pounds per square inch.

Tests have demonstrated the severe hazard of idle pallet storage. It is in the same class as storage of rubber tires and requires very special precautions for fire safety.

Storage on Pallets

Although the hazard of idle pallets is obvious, that of typical storage on wood pallets may not be apparent. In order to find out whether a hazard exists beyond the scope of sprinkler protection and, if so, what can be done about it, the Factory Mutual Laboratories have conducted an extensive fire test program during the past two years. This program included:

a. Empty steel drums on wood pallets
b. Bagged lime on wood pallets
c. Cardboard cartons on wood pallets
d. Paint products in cans in cardboard cartons on wood pallets.

Conclusions

As a result of these tests we have come to the following conclusions:

Idle Pallets

Large quantities of idle pallets should not be stored indoors in mass piles. Storage for day to day use should be subdivided into small units not exceeding six feet high, and preferably not over four feet high, under sprinklers. Bulk storage should be kept outside important buildings. Firestopping of the pallets will reduce the hazard appreciably and single piles of firestopped pallets, not exceeding eight feet in height, may be stored indoors under sprinkler protection.

Palletized Combustible Storage

The storage of combustibles on wood pallets constitutes a severe challenge to sprinkler protection, which increases out of proportion to the increase in pile height. Since, in general, goods are stored in cardboard cartons on wood pallets, our investigation has dealt with this kind of storage. Any arrangement which permitted the storage of loose combustibles on wood pallets would only equal or exceed the hazard of the cartons themselves. For instance, our tests show no appreciable difference in results between cartons containing paint in cans and the cartons themselves.

Firestopped Pallets

In order to safeguard palletized storage adequately with automatic sprinklers, it is essential that a firestopped pallet design be adopted as standard.

The exchange of pallets is quite common today. Pallets which carry raw materials into a plant may carry the finished or intermediate products out. In some industries there is a constant interchange of pallets between manufacturers, with the distributor serving as the intermediate exchange point. Again, transport companies will exchange pallets indiscriminately. In fact, it would be inconceivable that a particular style of pallet could be reserved exclusively for any particular user. Thus the adoption of a safe style of pallet as the national standard is essential if we are to reduce the fire hazard.

Early Alarm

The installation of a reliable smoke detector in areas where stock in cardboard cartons is stored on wood pallets, connected to an approved supervisory service or its equivalent, will permit early effective fire brigade action and thus might prevent a major fire loss.

Noncombustible Palletized Storage

The storage of inert materials such as steel drums (empty or containing noncombustibles) on wood pallets more than one tier high requires automatic sprinkler protection. Fire in this type of storage can progress throughout the pile in the absence of sprinkler protection, even though the only fuel available is in the pallets themselves.

Bagged Storage on Pallets

The storage of inert materials, such as bagged lime or cement, on wood pallets in multi-tier piles, may not require sprinkler protection since the material tends to spill from the bags, stop up the spaces in the pallets, and reduce the intensity of the fire. However, fire would spread slowly throughout such a pile if left unchecked. Fire-stopped pallets would prevent such spread.

Typical Test Setup

Figure 2 shows a typical test setup in the series involving "low density" storage in cardboard cartons. In all these tests the pile covered a floor area 25 feet long (six 4 ft. by 4 ft. pallets) by 12 feet wide (three 4 ft. by 4 ft.

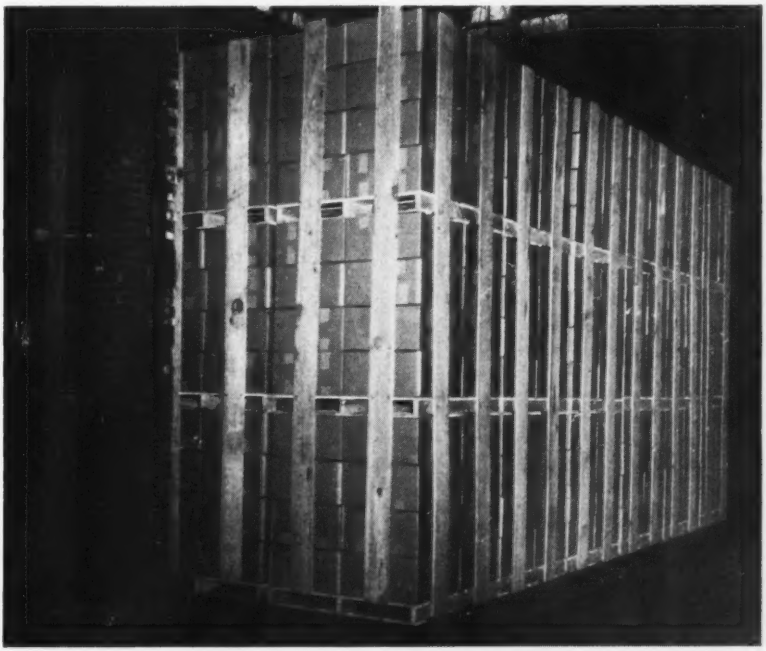


Figure 2. Typical test setup used at the Factory Mutual Laboratories involving cardboard cartons on pallets three tiers high. The vertical boards shown provided support and fuel for the test fires which were typical of that which would be provided if the cartons were filled.

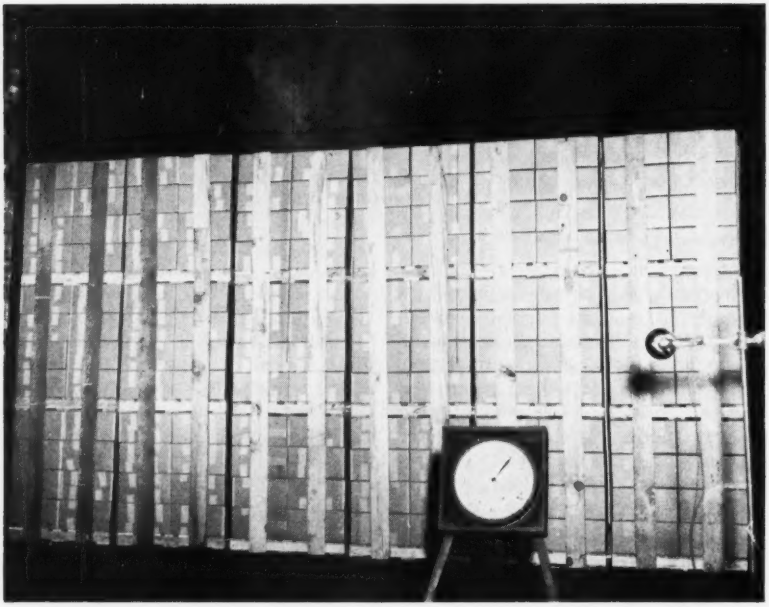


Figure 3. A typical test fire. 6 minutes, 21 seconds after a fire was started in the center of the pile between the second and third tiers from the left by means of a small roll of gasoline-soaked cotton ignited by an electric squib.

pallets). Height varied between three- and five-pallet tiers, or from 13 feet to 22 feet. The pallet channels were lined up so as to simulate storage from an aisle across the end of the pile. Spaces between adjacent stacks did not exceed two inches. The vertical boards shown in Figure 2 provided support and fuel typical of that which would be provided by carton contents, but at much reduced cost. The use of two such boards on each side of each tier was fully justified by preliminary testing in which no difference could be detected between this less costly arrangement and individual carton filling. This was later confirmed by tests of cartons containing paint in cans. Thus, in most of the tests, each pallet load consisted of 64 cardboard cartons, each having a one cubic foot capacity but each containing a cardboard liner only.

Sprinkler protection consisted of standard* automatic upright sprinklers on 10 ft. by 10 ft. spacing. Water pressure was held nearly constant at a point in the system above the origin of the fire. Thus sprinkler density was carefully controlled throughout each test.

All empty carton fires were conducted in an area 40 ft. by 60 ft. having a 33-ft.-high ceiling. The total number of sprinklers was 24. Observation of the fire was from a low ceilinged area adjoining.

Figure 3 shows a typical test in progress, 6 minutes, 21 seconds after the

*The standard sprinklers used in these tests by the Factory Mutual Laboratories were formerly called "spray sprinklers." [See NFPA QUARTERLY, Vol. 47, No. 3, January 1954, page 205 (or NFPA Reprint Q47-9) and NFPA "Standards for the Installation of Sprinkler Systems" (NFPA No. 13).]

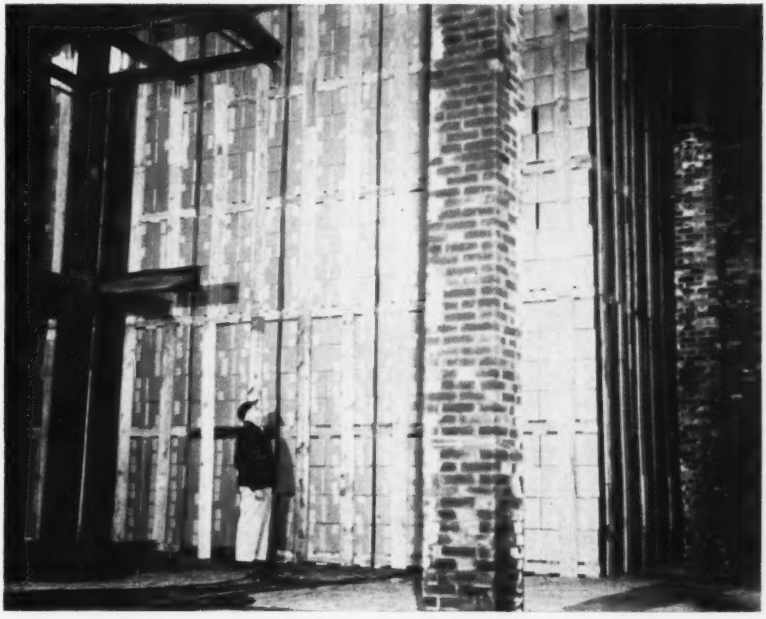


Figure 4. The largest test of palletized storage conducted at the Factory Mutual Laboratories was this stack 22½ feet in height. The pallets had been firestopped (see Figures 5 and 6).

start of the fire. Ignition in all these tests was at the center of the pile, two tiers in from the left end of the pile. The ignition source was a small roll of gasoline-soaked cotton, ignited by means of an electric squib.

Under observation throughout each test were:

a. Ceiling temperatures (recorded by 2 twelve point potentiometers)
b. Sprinkler head operation
c. Lateral fire spread

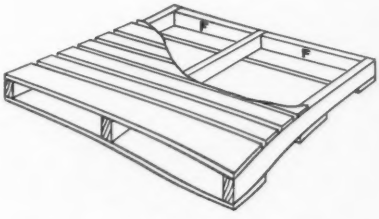


Figure. 5. The FM firestopped pallet. The firestops are marked "F". It is non-reversible, double face and has one-way entry.

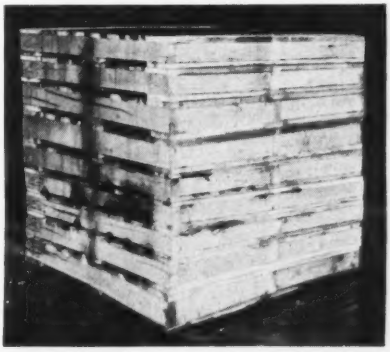


Figure 6. A stack of idle FM firestopped pallets. With these pallets, sprinkler control of palletized stocks was found much superior.

Table I

Summary of Results of Tests in the Empty Carton Series

	Type of Pallet				
	Conventional			Firestopped	
Pile Height	13 ft., 4½ in.	13 ft., 4½ in.	17 ft., 10 in.	13 ft., 4½ in.	22 ft., 3½ in.
Pile Height Number of Pallet Loads	3	3	4	3	5
Sprinkler Discharge Density — GPM/Sq. Ft.	.23	.29	.30	.23	.30
Number of Sprinklers Opened (24 possible)	24	23	19	14	12
Max. Ceiling Temperature (F)	1320°	1105°	500°	260°	285°
Max. 5 Minute Ceiling Temperature (F)	675°	750°	160°	160°	145°
Max. Lateral Fire Spread as Per Cent of Max. Possible	75%	56%	100%	44%	50%

Figure 4 shows the largest test setup, 22½ feet in height. In this arrangement the right end of every pallet has been firestopped by means of two short lengths of 2 in. by 4 in. material fastened between the stringers as shown in Figures 5 and 6.

Fire Behavior

In the fire tests involving empty cartons, the behavior of the fires was the same in every test. Fire would first travel vertically up between adjacent stacks above the point of origin. After a period of up to 10 minutes following ignition, the first sprinklers would operate directly over the fire.

The fires would then give an appearance of being subdued. However, lateral spread would take place through pallet channels. Again the fire would move vertically at the next interfaces between stacks, more heads would open and again a drop in temperature at the ceiling would indicate control.

In the piles involving ordinary pallets this sequence of events was typical. Tests ended when the fire was extinguished, controlled within the confines of the pile or all sprinklers operated without preventing spread throughout the pile.

Early in the program it became obvious that sprinklers alone, when supplied at any reasonable pressure, would not prevent lateral spread throughout this storage. Our observations of collapse of such piles showed that aisles of six- and eight-foot widths would be ineffective in preventing spread from one pile to the next.

Firestopping of Pallets

Firestopping of the pallets was a fairly obvious solution to the problem and two large scale comparative tests have confirmed its effectiveness. A study of Table I will show that from the standpoints of sprinkler density, number of sprinklers operating and hence total water flow, ceiling temperatures and lateral spread, the results with firestopped pallets were far superior to those with ordinary pallets.

The storage of paint and thinner in cans in cartons on wood pallets might

at first thought seem more hazardous than the cartons and pallets alone. Such is not the case, however. In the early stages of a fire in this storage, the wood and paper only are involved. By the time paint containers begin to burst sprinklers are operating. With firestopped pallets such fires can be extinguished by the discharge from a few sprinklers with high salvage of paint.

In a typical test (See Figure 7) on firestopped pallets, more than 9,000 gallons of paint in one gallon cans were used. The fire was extinguished by only six sprinklers operating at 15 psi pressure; and only 5 per cent of the containers were damaged sufficiently to leak.

One of the objections to the use of firestopped pallets has been that the pallets could be handled from one side only. In order to overcome this objection, the Factory Mutual Laboratories have devised two alternative designs to that shown in Figures 5 and 6.

Figure 8-A shows a firestopped pallet designed for use with a pivoted fork. When handled from one side, the forks would tend to spread, while from the opposite side they would turn in. Means would be provided to center the forks automatically after each operation.

Figure 8-B shows a design which would permit the use of fixed forks.

Pricing information indicates that these pallets could be obtained at an increase in cost of about 20 per cent above the cost of the type of standard pallets shown in Figures 1-A, 1-B and 1-C.

An important offsetting factor would be some reduction in the amount of damage to goods in adjacent piles due to protruding forks. With any of the various styles of firestopped pallets shown in the text, it is impossible for the forks to override the far side of the pallet.

Figure 7. One fire test in progress. This test setup involved 9,000 gallons of paint products in one-gallon cans stored in cardboard cartons on firestopped wood pallets.

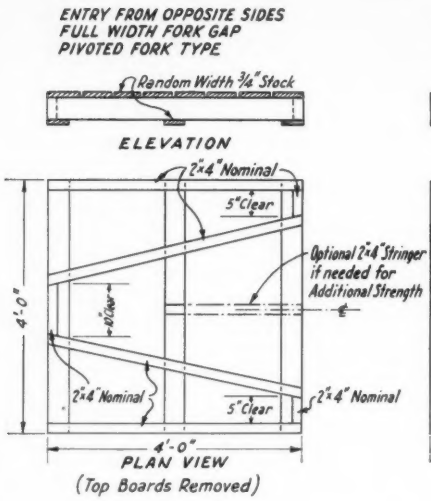


Figure 8-A. Firestopped pallet designed by Factory Mutual for use with a pivoted fork.

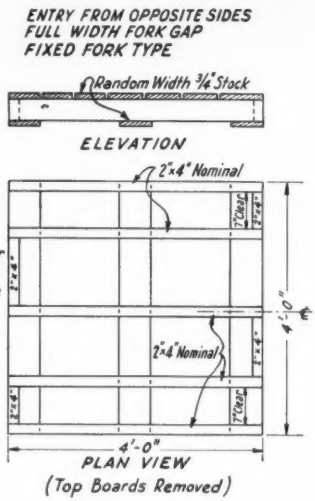


Figure 8-B. Firestopped pallet designed by Factory Mutual for use with fixed fork.

Fire testing of piles of idle pallets shows conclusively that, due to the restriction to air access, the firestopped pallets burn much more slowly than open pallets and that single piles up to 8 feet high are adequately protected by sprinkler densities* as low as two-tenths of a gallon per square foot per minute.

However, as pointed out earlier in this article, idle pallet storage in large bulk piles should be kept outside important buildings. Storage inside should be kept to a minimum, in well separated piles not exceeding eight feet in height, under sprinkler protection.

During this investigation one test was made with fire retardant treated† pallets. As a result of this test, it was concluded that open end fire retardant treated pallets would slow down but not prevent fire spread throughout the pile. Thus we believe that firestopping is needed here too, where combustible storage is involved. Such pallets offer little or no hazard, however, in idle storage and, where the stored goods are entirely noncombustible, sprinklers would not be needed for protection of the building contents. The use of firestopped pallets of fire retardant treated wood for the purposes indicated might be restricted further to those companies which retain pallets within their control.

*The discharge rate per sprinkler divided by the floor area protected by each sprinkler is the sprinkler density.

†Fire retardant treatment by pressure impregnation process.

Conclusions

Modern storage and materials handling techniques have brought about a serious fire protection problem. The chief factor contributing to this problem is the open wood pallet. Modification of the pallet in order to provide firestops will reduce the hazard substantially. However, industry-wide

adoption of the firestopped pallet is essential.

Idle pallet storage should be kept away from important buildings. Small lots of pallets for day to day use may be kept in the warehouse and plant areas but the height of piles of firestopped pallets should not exceed eight feet.

Pallets made of lumber which has been reliably fire retardant treated by the pressure impregnation process offer some advantage in storage of noncombustible goods. However, since exchanges may bring untreated pallets into the plant, the use of retardant treated pallets can only be adopted under strict control. When used with combustible storage, these pallets also should be firestopped.

Any pallet which leaves no space between adjacent tiers in the pile is preferable to those types which create ventilation layers, regardless of their construction. Some types of paper pallets offer a decided improvement in this respect.

In storage areas where corrugated cardboard containers or other common combustibles are prominent in the pile, an approved early warning smoke detector, sounding an alarm so as to bring prompt response by the public fire department or a well-trained plant fire brigade, will help to prevent the development of deep seated smoky fires.

The Factory Mutual Engineering Division has discussed the results of this entire testing program with the National Wood Pallet Manufacturers Association. The significant factors disclosed by the tests were quickly recognized and the Association is taking steps to work out an improved pallet design.

Meeting of Board of Directors

Los Angeles, May 20, 1957

Present

Richard E. Vernor, Chairman
John A. Neale, President
Henry G. Thomas, Vice President
Loren S. Bush, Vice President
Allen L. Cobb, Past President
T. Seddon Duke, Past President

Warren J. Baker	W. H. Forristall
Malcolm S. Blake	A Leslie Ham
A. L. Brown	J. Sharp Queener
Charles H. Bunn, Jr.	Elmer F. Reske
Franklin R. Fetherston	Roger H. Wingate

Percy Bugbee, General Manager; Robert S. Moulton, Technical Secretary.

1. Chairman Vernor's report to the annual meeting was read and approved.

2. Treasurer Freeman's report to the annual meeting was read and approved for presentation by Mr. Bugbee.

3. a. It was voted to recommend postponement of action on the proposed amendment to the Articles of Association dealing with an increased charge to cover postage for foreign members; the recommendation on increase in dues and on life membership to remain without change.

b. Mr. Reske presented a request from the Illinois Inspection Bureau (organization member NFPA), that consideration be given to establishing a grade of junior member at a reduced scale of dues. This was referred to the NFPA staff for consideration and report at a subsequent meeting of the Board.

4. a. In response to a request from the Committee on First Aid Fire Appliances, the name of this committee was changed to "Portable Fire Extinguishers," and recommendation made to the annual meeting that Standard No. 10 on "First Aid Fire Appliances" be changed to "Portable Fire Extinguishers."

b. It was voted to authorize the presentation to the annual meeting of the revised report of the Committee on Chemicals and Explosives on the Suggested Ordinance on Explosives.

c. The question of model ordinances vs. standards as a form for committee reports was referred to the Technical Advisory Committee for report to the Board at a subsequent meeting.

d. Mr. Cobb, Chairman of the General Committee on Special Extinguishing Methods, reported on the inclusion of the factor of design of extinguishers in the report on Portable Fire Extinguishers, indicating general concurrence in the plan.

5. It was voted to confirm the dates and place for the 1957 Fall Conference, Richmond, Virginia, November 18–20, 1957, at the John Marshall Hotel.

6. It was voted to confirm the holding of the 1959 annual meeting in Atlantic City, N. J., May 25–29, with headquarters at the Hotels Dennis and Shelburne. (The 1958 meeting in Chicago, May 19–23, previously confirmed.)

7. Mr. Bugbee reported on the Sparky program. This report was approved.

8. Mr. Bugbee reported on Distinguished Service Awards. This report was approved.

9. A circular letter from Mr. E. F. Tabisz, General Manager of Underwriters' Laboratories of Canada, proposing the establishment of a Canadian Section, was read and discussed without action.

10. It was agreed to hold the next meeting of the Board in Boston on July 1, 1957.

11. Retiring Board members Fetherston, Wingate and Brown expressed appreciation for the privilege of serving on the Board.

Constructing Dwellings for Life Safety

By Richard E. Stevens, NFPA Engineer

Annually about 11,000 people die in fires of all types. Of this number nearly 4,000 fire deaths occur in one- and two-family dwellings. This is the greatest number of fire deaths to occur in any one type of occupancy. Therefore, we should be doing our greatest work in promoting fire safety in dwellings.

Progressive development by industry has eliminated a great many home fire hazards, but, with the elimination of some of the more hazardous types of old-fashioned devices, a whole new realm of gadgets now fill most every dwelling. In addition, many new types of building materials have been made available and methods of construction have changed. Whether these new materials and construction techniques represent progress in fire safety is a debatable question.

The building boom in one- and two-family dwellings in the United States in the past 10 years exceeds any in the history of the nation. It is apparent, however, that we have not challenged this growth with improved fire safety.

What is Being Done

The NFPA has carried on an outstanding educational program in fire safety for quite a few years. One medium is *Sparky*, which has brought his message of home fire prevention to the attention of millions of Americans. Undoubtedly this program has done a great deal to bring fire safety to the minds of homeowners.

Similarly the NFPA has been very active in the development of standards pertaining to dwellings. A few such standards are the National Electrical Code (NFPA No. 70), Residential Type Warm Air Heating and Air Conditioning Systems (NFPA No. 90B), Fire Protective Construction on the Farm (NFPA No. 223), Oil Burning Equipment (NFPA No. 31), Gas Piping and Appliances in Buildings (NFPA No. 54), and the Building Exits Code (NFPA No. 101).

More cities than ever before have adopted building codes, some of which have fire protection provisions applicable to dwellings. One of the briefest references is contained in a code used in a small town in Massachusetts which has two provisions pertaining to fire safety. One requires fire stopping in stud and joist channels, and the other requires the use of a thimble where a smoke pipe passes through a combustible partition.

Insurance companies have carried on a continuous campaign in home fire prevention. Many fire departments have and are now conducting home inspections under the sponsorship of the International Association of Fire Chiefs and with the support of the NFPA. The permanent value of this work is increased where fire prevention literature from authoritative sources is distributed at the time of the inspection.

These and many other things are being done but the emphasis is principally on the education of the public in fire prevention. It is a well-known fact that it is most difficult to overcome human error. We should also place a great deal of our emphasis on providing more standards and more guidance on fire safe construction of dwellings.

Local codes and other restrictions now regulate the size of the home-

Based on a paper presented by the author at the 61st NFPA Annual Meeting held in the Hotel Statler, Los Angeles, Calif., May 20-24, 1957.

Jefferson Fire Dept.

Figure No. 1. Three persons suffocated in this one-story ranch house on January 15, 1957 in Jeffersonville, Indiana as flames spread with lightning speed over pressed paperboard covered walls. Are houses being built in your community with this type of highly combustible interior finish?

owner's lot, the construction of his dwelling, its location and in some areas its character and size. Other codes regulate the plumbing, sewage disposal and wiring. When a homeowner gets through meeting all such regulations, he then pays a tax on what he has acquired. The feeling seems to be that the only way to assure a certain minimum standard of living conditions is to regulate through laws and ordinances, and good or bad, this philosophy is being applied in a great many fields, including the fire protection field. We must be careful, however, not to propose regulations counter to the traditional concept of maintenance of the sanctity of the home, free from outside interference.

What is Not Being Done

The greatest laxity in the promotion of home fire safety pertains to dwelling construction and protection and to the adoption and enforcement of regulatory ordinances and standards on the local level. A recent example of this was revealed in a report that the NFPA Fire Record Department received of a fire in a dwelling which took the lives of three occupants on January 15, 1957. (See Figure No. 1.) This was a relatively new house of the ranch type, a typical speculation house. The fire apparently originated in a television set, ignited the draperies and spread rapidly over the pressed paperboard covered walls, suffocating the occupants before they were able to escape via the windows. There were other factors involved in this fire which contributed to the loss of life. The occupants slept with their bedroom doors open and windows closed. One of the occupants who was awakened by the smell of smoke attempted to throw the burning television set out of the front door but was unable to do so. By the time he reached the

bedrooms to warn the other occupants, he was overcome by heat and smoke.

But the interesting part of this report was a statement made by the local fire chief, pertaining to the paperboard covered walls. The statement was: "It should be against the law for anybody to use this stuff in residences." Obviously there should be a law against the use of materials of that type in residences but who, in a small community, is in a better position to promote such a law than the fire chief? Interestingly enough this material was approved by both the Federal Housing Authority and the Veterans Administration. Although we were not able to obtain samples large enough to determine the flame spread characteristics of this particular material, it has been estimated that it would possess an even greater flame spread than untreated fibreboard if delamination occurred during fire exposure, and it did occur.

Many building codes are out of date as they pertain to construction methods and materials. This is reflected in the general over-all fire protection problems, but it is just as applicable to dwellings as to other occupancies.

It might be said that there is general complacency and little thought given to the type of materials used in dwelling construction. It is doubtful if general contractors who build houses by the hundreds on a speculation basis give any thought to fire safety other than to meet the local requirements, if any. Perhaps it would be unjust to say that these contractors are not interested in what happens to the house or its occupants after they unload it by sale. It probably is more reasonable to say that they are not familiar with what happens in dwellings under fire conditions and what they could do to overcome these conditions. The emphasis seems to be primarily on building houses as inexpensively as possible, cutting corners if necessary, and providing as many sales gimmicks as are feasible to attract the public. "Sales gimmicks" refer to dish washers, garbage disposals, paved driveways and similar frequently advertised advantages which builders install in their speculative houses. There is a great deal of fire safety education to be done among builders.

Typical Poor Construction Features

Some common recent building techniques which are beginning to show up in fire record experience include the following:

1. Use of highly combustible interior wall and ceiling materials. These include such materials as pressed paperboard, untreated fibreboard wall panels and ceiling tiles, and plywood panels prefinished with highly flammable lacquers. Figure No. 1 shows the results of the fire mentioned earlier. This is a typical speculation house but it was sheathed on the interior with a pressed paperboard that delaminated during the fire. Three persons died in the fire; one man aged 48, one ten-year-old boy, and a girl of 17.

2. Use of plastic tiles and panels which may not possess high flame spread characteristics but which do burn readily and some give off products of combustion that are toxic. It is known that more than the usual amount of smoke and soot is generated by many plastics. Experimental models of entire houses of plastic are being subjected to various field tests for durability and strength, but not for fire safety.

3. Use of small windows with sills 5 or more feet from the floor, particularly in bedrooms. The Building Exits Code recommends at least one window in every bedroom not having two doors which provide separate ways of escape, or one door which leads directly to the outside. The latter door must be operable from the inside without the use of tools to provide a clear opening of not less than 18 inches in least dimension with the bottom of the opening not more than 4½ feet above the floor. Figure No. 2 shows a house with the type of windows that would probably

be worthless as emergency exits. The glass size is estimated to be 12 inches high, 30 inches long. Even where there are two panes in one window, the center mullion is so large it could not be broken out by any ordinary means. Figure No. 3 shows a rear view of the same house.

4. The contemporary design practice of not carrying partitions up to the ceiling.

5. The growing trend towards the elimination of doors or the use of folding plastic coated fabric and lightwood slatted folding doors. Most modern house plans of the ranch or single story house place the bedrooms all together at one end of the house. In many cases the bedroom area could be completely shut off from the rest of the house by a door. Most new "split level" homes have an open stairway from the basement to the second floor. Consider Figure No. 4 which shows a typical plan for a three bedroom ranch house. The type of floor plan is common to the average ranch house being built today. If a door were put at the end of the hallway (as marked by the arrow), all bedrooms would be segregated from the rest of the house. Figure No. 5 shows a floor plan for the popular "split level" house. Notice that the stairway is open from the basement to the second floor where the bedrooms are located. Again the installation of one door and casing (as marked by the arrow), costing roughly $16.00 plus labor, would shut off the sleeping quarters from the remainder of the house. Builders could put a sticker on the door reminding the homeowner that "this door was installed to save lives if kept closed at night."

Figures No. 2 and 3. These two views of a modern home show how difficult escape via windows might be if occupants were barred by smoke from using the front and rear doors. Such designs show the need for guidance on home fire safe construction.

6. The comeback of wood shingle roofs. From a fire safety point of view wood shingle roofs present a surface readily ignited by chimney sparks or brands from exposure fires. Such roof fires are not easily detected by occupants.

These are just a few of the modern building techniques that are not fire safe and that are not being corrected. A recent survey of 1,000 dwelling fatalities by the NFPA Fire Record Department showed that 844 people were trapped because of delayed discovery or rapid spread of fire. The next largest number of deaths (157) occurred because of inadequate exit facilities. This study indicates conclusively that all of the poor "techniques" just mentioned must be corrected if we are going to reduce dwelling fire deaths.

What Can Be Done

The NFPA should develop more guidance material to aid builders and homeowners in (1) selecting the proper materials for fire-safe home construction, (2) the proper assembly of the materials selected, and (3) arranging for adequate means of escape.

Figure No. 4. A door in the hall leading to the bedrooms (at the point indicated by the large arrow) would segregate this section of the dwelling and provide at least a temporary cut-off to give occupants opportunity to escape if a fire should start during the night in one of the other rooms in the house. An automatic fire detection system in the home would provide prompt alarm.

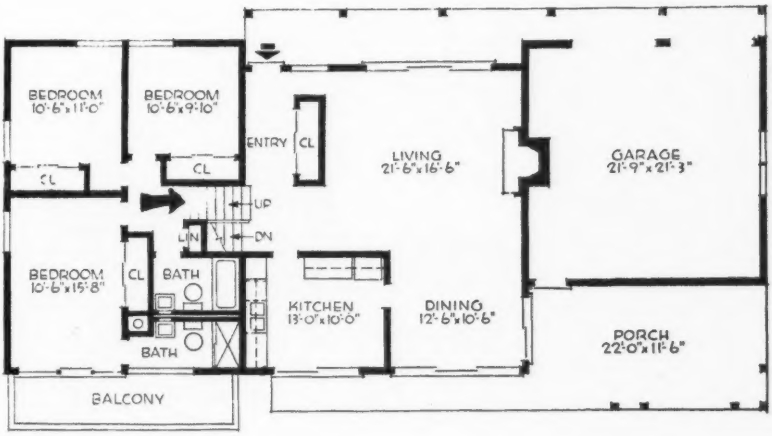


Figure No. 5. In this split level ranch a door at the head of the stairs would provide segregation for the sleeping area from the balance of the dwelling, and with a detection system occupants would have ample time to escape.

Fire department people and building inspectors (these two groups should work together on this problem) are probably the NFPA members most closely concerned with the dwelling fire safety problem. They probably are also the people who can do more about it than any others. Certainly they can work together on practical building codes containing provisions for fire safety based on the recommendations of the NFPA Building Exits Code, that are up to date, and that most economically meet the fire spread problem in dwelling construction.

A typical recent example of fire building official cooperation took place in California. A rash of fast spreading fires in dwellings, involving an imported plywood with an inadequate adhesive to hold laminations together, prompted some immediate regulations. One such fire is illustrated in Figures No. 6 and 7. Tests indicated that delamination occurring under fire conditions resulted in the material having a flame spread rating of over 300*. Cooperation between the fire departments, fire protection engineers, and building inspectors brought about local legislation prohibiting the use of interior finishes possessing flame spread characteristics of over 250*. The Building Exits Code limits flame spread to 200 in such situations.

Fire chiefs can work with local newspapers in providing all possible coverage of fatal fires that occur within their jurisdiction and on promoting editorials on fire safety in the home. Most large newspapers have weekly editorials

*See NFPA "Fire Tests for Fire Hazard Classification of Building Materials," NFPA No. 255 (ASTM E84-50T), published separately and in Vol. III of the National Fire Codes.

Santa Clara County Fire Marshal

Figure No. 6. This is the living room wall of one of the California homes which had an imported plywood interior finish. The plywood delaminated under fire attack and burned rapidly. (See also Figure No. 7.)

Santa Clara County Fire Marshal

Figure No. 7. In a section of the same dwelling gypsum wall board was used. Note how the wall studs here are uncharred compared with the deep charring shown in Figure No. 6 where an imported plywood was used.

devoted to "do it yourself projects" and periodically these editorials might be devoted to projects that would improve dwelling construction to reduce the fire spread problem. Editors are eager for reliable information on such subjects.

Fire chiefs and building inspectors are in a position to work with local contractors to influence them to emphasize features of fire safety design along with comfort. Possibly some home speculation project has advertised homes designed for fire safety and which offer such things as bedrooms capable of being completely shut off from the remainder of the house, walls and floors completely fire stopped, interior finish meeting the requirements of the Building Exits Code, windows large enough to escape through, a complete system of automatic fire detection or a sprinkler system. These might be just as good sales gimmicks as an automatic dish washer or a garbage disposal unit.

Government agencies concerned with residential construction need fire protection guidance. Everyone is concerned with economy, but economy that jeopardizes life safety is specious. The fire record indicates that not enough thought is given to fire safety considerations by federal agencies in issuing approvals of building types and construction.

Architects, being generally responsible for the original house plans and specifications, hold a key to fire safe construction. It seems that architects are not meeting their objectives, either. The following is a quotation from the "Purpose" of the American Institute of Architects: "to coordinate the profession of architecture and the building industry

to ensure the advancement of the living standards of our people." Designing a home that is not fire safe is not advancing the *living* standards of the people who will occupy the house.

Architects are thinking about fire safety and design structures only to the point of meeting the local codes, if any.

Architects submit plans to consulting engineers for details on things like structural features and building equipment. How often do they submit plans to fire protection engineers for guidance on fire safety?

Fire protection equipment manufacturers have a definite role to play in the home construction and protection fire safety picture, since they, like others in the fire protection field, have not given enough thought to the homeowner. As a result smalltime operators take over the home field and sell the homeowner a substandard fire protection device of little or no actual fire safety value. There is real need for a reasonably priced home fire detection system, an economical home sprinkler system and low priced extinguishers, fire doors and other equipment applicable to dwelling use. The whole fire equipment field for dwellings is entirely distinct from other occupancies and separate standards of testing and performance should be set up to allow general use of this equipment within the range of the homeowner's pocketbook. Inferior or substandard devices and equipment should not be developed. For example, if a homeowner desires to have a fire door between his garage and dwelling the price is so prohibitive that he ends up buying a flush wood door and nailing sheet metal to it, which probably would be adequate to serve the purpose. Industry misses the boat when it fails to make such doors available to homeowners for less than double the price of any other door in the house.

There must be a vast field of sales for home fire equipment, if fire equipment manufacturers would produce devices within the economical reach of the homeowner that are reliable and of actual fire safety value.

The groups of NFPA members previously mentioned are but a few of our wide scope of representation. Actually all NFPA members should be concerned with these dwelling fire problems. Every individual can talk with his neighbor and his friend about the fire problems in their homes. Actually most homeowners and family people are very much interested in this problem and relish the thought of talking with someone who knows the answers. Must we, as usual, wait until the dwelling fire death figure reaches such proportions that drastic steps finally are taken? This is the usual method in fire protection but in the case of dwellings we are concerned with life safety and no measure of insurance payments or regrets for human errors can replace the loss of human life. Let's face the problem now and do something about it before thousands more Americans needlessly die in home fires.

The Jaguar Factory Fire

By Norman Strother Smith

Director, Fire Offices' Committee

Fire Protection Association

Fire which resulted in a loss estimated at 2,000,000 pounds sterling (about $6,000,000) broke out shortly before 5:45 p. m. on February 12, 1957 at the factory of Jaguar Cars, Coventry, England. The cause of the fire has not been established but might have been a carelessly dropped match or cigarette. The outbreak started in or near the tire storage section situated in a corner of the chassis warehouse on the northeast side of the premises. Several employees in or near the place of origin between 5:30 and 5:40 p. m. who had an uninterrupted view of the area did not notice any sign of fire. The fire was discovered when the flames were seen breaking through the roof and the alarm was given over the plant intercommunication system at 5:45 p. m.

The factory, built in 1939, was owned by the Ministry of Supply and leased to the Jaguar Company. The main factory, a single story building, covered an area 1,530 ft. long by 400 ft. wide and was 20 ft. to the eaves. There were 51 bays, each measuring 400 ft. by 30 ft. One of

Arthur Cooper, Coventry

Lack of automatic sprinkler protection in this 612,000 square foot automobile factory in Coventry, England permitted flames to cause about $6,000,000 damage to the structure on February 12, 1957. The fire attracted international attention because of its general similarity to the General Motors factory fire at Livonia, Mich. which occurred on August 12, 1953. (See October 1953 NFPA Quarterly or NFPA Reprint Q47-2.)

Keystone Photo

The fire spread through the Jaguar factory assembly line very rapidly, causing heavy damage to about 300 finished cars. Employees, including office staff, pushed or drove between 300 to 400 cars to safety. The principal factors responsible for the rapid flame spread were (1) the bituminous roof cover, (2) the soft insulating fibreboard used as roof lining and, (3) the rubber tires stored in the structure in the area of fire origin.

the bays which ran the width of the factory was originally used as an internal link road. Most of this has now been built over by the construction of a new paint shop, and the rearrangement of the assembly tracks.

The roof, saw-tooth type with glass lights in north panels, consisted of bitumen-coated corrugated metal sheeting underdrawn with soft fibreboard. In some parts there was a space of two or three inches between the board and the metal sheeting, in others the metal sheeting lay directly on the fibreboard. The whole was supported on unprotected steel stanchions and roof trusses. The lights were of wired glass. The external walls were of brick and there was no really effective fire stop throughout the main factory, such partitions as there were being generally of combustible materials or wire mesh. The floor was of concrete.

There were five static water tanks, one of 250,000 gallons,* two of 150,000 gallons* and two of 50,000 gallons.* A six-inch town main ran through the factory with hydrants in the link road and paint shop. A six-inch and four-inch private ring main was supplied from the 150,000-gallon* static water tank. There were ample supplies of water for the thirteen pumps used to fight the fire.

The fire in the tire storage area was attacked immediately by the plant fire brigade. The Coventry Fire Brigade received a call at 5:46 p. m. and when the first appliances arrived it was found that

* Imperial gallons. 1 Imperial gallon equals 1.201 U. S. gallons.

the plant brigade was fighting the fire with two hose streams from hydrants and that the fire had spread the width of three bays and 250 feet along the width of the building. By 6:00 p. m. the fire had spread along the whole width of the building and had advanced six bays. One member of the staff of the company who made his way through the factory in the early stages stated that the fire travelled along the roof quite as fast as he could walk. The bituminous covering of the roof sheeting and the soft insulating fibreboard used in the construction of the roof burned very fiercely and fire spread quickly along the roof always at least 40 feet ahead of the ground fires which were assisted by falling bitumen and burning flakes of fibreboard.

At the height of the fire a tremendous amount of smoke due to the large quantity of burning rubber and the bitumen on the underside of the roof made it difficult to see even outside the building. Firemen operating hose streams in the link road had to wear breathing apparatus.

At about 7:00 p. m. two acetylene cylinders burst. Fortunately no one was injured; the explosion brought down part of the roof and provided ventilation for the fire. This helped to disperse the smoke and allowed firemen to see and appreciate the situation more clearly.

The fire was brought under control in 2½ to 3 hours although several pockets remained.

The roof structure over the area of origin of the fire collapsed about 30 minutes after the discovery, bending the rolled steel joists used in the wall construction and pulling down four gable ends. Sections of the metal roofing sheets fell on the burning debris and

Arthur Cooper, Coventry

Showing how the walls collapsed at the Jaguar factory fire as unprotected structural steel roof supports failed under heat attack. Seven of the 400 ft. by 30 ft. bays collapsed or partially collapsed during the fire. Fire fighting in the structure was handicapped due to heat and smoke until oxy-acetylene cylinders exploded and blew a hole through the roof which vented the fire and smoke.

prevented, to some extent, hose streams getting at the fire.

Twelve of the bays were severely damaged by fire, sections of seven of them partially collapsed. The damaged sections had housed the chassis warehouse (which included the tire storage area), the saw mill, assembly and finishing tracks, cabinet shop, engine reconditioning and repair service departments. Damage to the lacquer and enamelling shops was less severe. The contents that were destroyed included 300 finished cars, cars of customers awaiting repair, a large quantity of tires, chassis components, batteries, rubber body mountings, axles, fuel pumps, saw mill machinery and reconditioned engines.

Maintenance workers and office staff, the only employees on the premises at the time helped to push or drive between 300 and 400 cars to safety. When all the lights failed they worked by the light of car head-lamps.

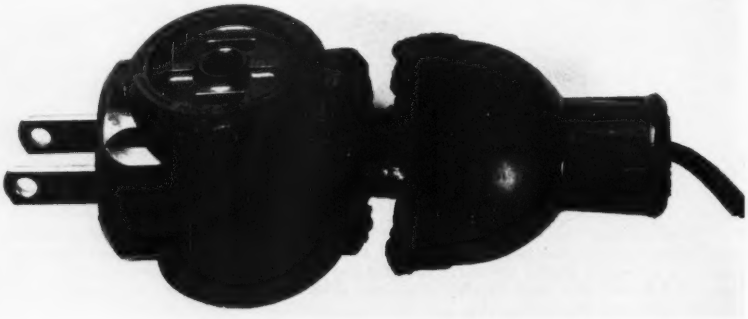
This account is based largely on information provided by the Chief Fire Officer of the City of Coventry to whom acknowledgment is made.

Why Use Labelled Equipment?

In many NFPA Standards, the recommendation is made to use "approved equipment." This means "approved by the authority having jurisdiction." The suitability of devices is often indicated by the listings of nationally recognized testing laboratories. Nowhere is this more important for fire and life safety than in the electrical equipment field.

The photo below shows the remains of an *unapproved* electric attachment plug made available to the NFPA by the Hardware Mutuals of Stevens Point, Wisc. A building mechanic bought this plug (and others like it) for some electric typewriters after the original plugs had been broken. They were purchased from an electrical equipment wholesaler. Three of the plugs purchased burned but, fortunately, none resulted in a major loss. Examination showed that the metal parts were held to the rubber by only one riveted metal pin which did not give sufficient rigidity to the assembly, that the metal parts were made of ferrous materials, and that the electrical resistance between the metal pins through the circular path in the molded rubber was 28,500 ohms, this latter condition resulting in a 4 milli-amp current flow through the rubber body of the plugs.

The Underwriters' Laboratories, Inc. "Standard for Attachment Plugs and Receptacles" is protection to assure that minimum quality and safety is achieved with this type equipment. A "UL" label on an attachment plug assures that the plug has passed this Standard. The plugs referenced herein would not pass the Standard.



Areas of Ignorance in Building Design

By Horatio Bond

Chief Engineer, National Fire Protection Association

A newspaper statement I was asked to make in January 1957 is responsible for this article. The statement was to the effect that destruction of churches would continue as long as architects ignore the fire problem in the design of churches.

The response of spokesmen for architectural offices was to the effect that churches were designed to meet fire safety requirements which had been spelled out in laws and regulations. This response simply proved the point.

The situation which is most desirable is where the architect himself makes up his mind about matters of fire safe design. It is proper for fire safety measures to be specified in laws and regulations, but these are never going to provide as satisfactory a solution of the fire and other problems of building design as the intelligent and imaginative solution of these problems by the architect who has a full understanding of the factors involved.

Instead of getting imaginative treatment, the fire problems are too often simply ignored, not only by architects, but by others. Some cases have been selected to illustrate what might be described as areas of ignorance in building design.

The newspaper story was in response to a great deal of interest last winter in the problem of church fires. In one of the news releases in January which went out nationally, the Associated Press listed some twenty-one fires which had occurred in the first two weeks of that month and thirteen others which had occurred in the latter part of 1956. These fires were not invented. Each one of them involved the destruction of a church which had at one time been on an architect's drafting board.

It is possible to mention only a few of the areas of ignorance of fire problems which are reflected in the day-to-day fire record of churches and other buildings. There are six such areas which I have selected for consideration. These are all areas which are frequently ignored in the design of some buildings. These are not necessarily in order of importance.

Bulk of Combustibles

One area of ignorance is with respect to bulk of combustibles. One of the worst types of fire is that in a lumber yard for the obvious reason that there is a lot of combustible material in one place. If you build a building of fire-resistive construction but then support the roof on wood joists and a wood roof deck, you have in effect put a lumber yard on top of the building. This particular feature of building design is an example of the factor of bulk of combustible material.

Bulk of combustible material is a major factor in warehouse fires. Many building designers are ignorant of the fact that the fire load in a warehouse occupancy almost always provides a fire exposure which will exceed the fire resistance which is built into the structure.

Certain commodities which may be found in a warehouse produce fire loads far in excess of the loads produced by ordinary merchandise. An example is rubber, for which the fire load in British thermal units per square foot of floor area is approximately double the fire

Based on a paper prepared by the author for presentation at the 61st NFPA Annual Meeting held in Los Angeles, Calif., May 20–24, 1957.

load resulting from furniture storage. Rubber is much worse than most other materials because it produces heavy smoke and in its usual forms, tires, foam and scraps, exposes many combustible surfaces to rapid ignition. In these forms, the material is also difficult to handle. In a warehouse occupancy it is less important to have fire resistance for structural members of the building than it is to have the building of the proper shape. Fighting fire frequently requires the actual pulling apart of materials which are affected by a fire which, in turn, means that, for warehouse purposes, a long, narrow building not over one story is to be preferred.

Building Dimensions

A second area of ignorance is the way which building dimensions affect the fire problem. As long as a building space is relatively small it is possible to fight a fire by using hose streams operated by fire fighters. In general, architects have no real appreciation of the job of fire fighting which may be presented by certain room spaces and building spaces.

A man with a hose stream can put water about fifty feet from where he is standing. If a building is designed for manual fire fighting, this limitation must be kept in mind. Of course, water can be thrown with big streams and a great deal of expensive equipment for distances up to two or three hundred feet. As a practical matter these large streams are used by fire departments principally to reduce the radiant heat from fires which are already out of control. We have thousands of pictures of fires to prove this point.

So, there is a factor of dimension which must be in the mind of the design architect.

On the day that I talked with the Boston representative of the Associated Press, I had on my desk a newspaper clipping showing a wooden roof deck of a church burning. It was obvious from the dimensions of the building that this combustible feature of the structure was located at a point where firemen could not reach it with hand hose streams. A dimension detail of this sort reflects the fact that the architect did not understand the fire problem or had decided to ignore it.

Heat, Smoke, Poison Gases

A third area of ignorance is concerned with the heat, smoke and poisonous gases which are given off by anything that burns. The design of the General Motors Plant at Livonia which burned in the biggest industrial fire disaster of history was an example where this factor had been ignored. Buildings need roof vents or some means to carry off heat, smoke and poisonous gases.

This factor is particularly serious if ignored in buildings having no windows and building spaces underground.

Fire Characteristics of Materials

Another area of ignorance is in connection with the fire characteristics of materials, both the way materials burn and the way they resist damage by fire.

The rate at which the burning of a material produces heat and the total heat produced are fundamentals because they affect the timetable and duration of a fire. They determine the rate at which water for fire extinguishing must be applied and the total amount of water which may be needed. As mentioned earlier, rubber tires give off much more heat per pound than other combustibles, such as wood and paper.

The form of the material is a contributing factor. It makes a difference whether it is solid, granular, fibrous, a liquid or a gas. The usual container or covering must be considered. These factors determine the readiness by which the material may be ignited — by radiant heat, by sparks or by other small heat sources. They determine the relative difficulties encountered in fighting fire in the material.

In mentioning the bulk factor earlier, it was noted that in certain materials a

fire can only be fought by actually pulling apart the piles in which the material is stored. For this you must think about something other than the conventional fire fighting apparatus. For this operation cranes, clam shell diggers, bulldozers and other material handling equipment is necessary.

Of course, the foregoing is a very abridged treatment of the subject of materials. There are other factors which have to be considered, for example, in connection with fireworks and explosives, with oxidizing materials and acids, with materials subject to spontaneous ignition. Toxic and radioactive characteristics affect decisions as to how certain materials may be stored. Substances like pyroxylin and charcoal are dangerous when subjected to moderate heat. Phosphorus is dangerous when exposed to air or friction, and calcium oxide is dangerous when exposed to absorption of moisture.

Then there is the action of materials which are safe by themselves, like oxidizing materials and organic substances, but dangerous in combination.

It is also necessary to know about characteristics of materials in connection with the selection of the structural components of buildings. Even the characteristics of familiar materials are not as well understood as they should be. Few building designers are willing to admit to themselves that bare structural steel keeps its strength for very brief periods of fire exposure. The behavior of steel at fire temperatures is simply ignored in connection with many of its uses in buildings.

The area of ignorance of materials must be considered particularly when new materials are proposed for use as building components. At the moment, the plastics industry is facing up to the fact that it has a problem with respect to meeting the areas of ignorance in the fire behavior of many of the plastic materials which could conceivably be used for building components. Numerous plastics do not perform well at temperatures outside the normal ranges. At the moment, the industry is taking the position that the yardsticks used as a measure of fire resistance for conventional building materials should not be applied to plastics. However, if the present yardsticks of fire resistance are proper for conventional building materials, they are safe yardsticks for new ones.

It is reasonable to assume that a number of plastic materials will be found to have perfectly satisfactory uses in building construction, but these materials must be used with the proper understanding of their behavior under fire conditions.

Automatic Sprinklers

To the fire protection engineer, the most aggravating area of ignorance in architects' work is their failure to understand the value of automatic sprinkler systems for the protection of buildings. This is an area of very real ignorance. It is due to the fact that very few practicing architects have ever had the occasion to satisfy themselves as to what the functions of these systems may be or how their components work.

The false notion that sprinkler systems are somehow a source of water damage is widely held. The average architectural office today would advise against automatic sprinkler protection for a museum or a library. Yet, water damage is always likely to be greater in the unsprinklered than in the sprinklered building, should a fire occur. This is because a fireman's hose stream is likely to put five to ten times as much water per minute into the building in case of fire than the sprinkler system would.

A larger percentage of building floor space is likely to be lost in a fire in an unsprinklered than in a sprinklered building.

These are simply facts, but they are not well understood.

It is possible largely to eliminate combustible materials in a building structure itself. It is seldom possible to eliminate combustible contents. Wherever building contents are of real or intrinsic value, automatic sprinkler protection provides the most efficient means of dealing with the burning of any of the combustible contents.

Another place where sprinklers are needed is in buildings where there could be loss of life. It is of great importance that nursing homes and hospitals be sprinklered regardless of their construction. This is a matter of protection for the people in the building, many of whom cannot readily move or be moved. When arguments are advanced against sprinklers in these occupancies as a measure for life safety, it is simply a manifestation of ignorance.

There is only one answer to dealing with this particular area of ignorance. Architects have got to spend some time finding out what goes on with respect to the pipes and valves and other components of a sprinkler system. These are unglamorous, but they can respond to imaginative treatment if architects will give them the same amount of time and attention that they give to other details of a building.

The problem of appearance of the pipes necessary in a sprinkler system is by no means insoluble. This factor of appearance is one which requires the talents both of the architect and of the sprinkler engineer who may be responsible for making the system perform.

The Cape Playhouse at Dennis, Massachusetts is sprinklered. In this case, the architect solved the problem of sprinkler protection even though sprinkler heads had to appear on a ceiling which was decorated with a Rockwell Kent mural. The architect and the sprinkler engineer got together to decide where the heads might appear, and there was no difficulty agreeing on a layout which got the heads on the ceiling in proper places and at the same time did not in any way detract from the details of the mural.

Many historic buildings are protected with automatic sprinklers. To mention only a few, there are the Old South Church and Faneuil Hall in Boston and Independence Hall in Philadelphia. Yet, every year many of our historic unprotected landmarks are lost in fires. Architectural offices could find for themselves some real business in working out the protection of these buildings against fire through installation of sprinkler systems. To do this, they must stop ignoring the possibilities of automatic sprinkler protection.

Surface Flame-Spread

There is one other area of ignorance which needs to be stressed because it is an important factor in loss of life due to fire. This particular area of ignorance deals with the rate at which flame may be expected to spread over various materials used for surfaces of walls and ceilings.

Some of the materials used for these surfaces spread flame very rapidly. They may involve an entire room area in fire much sooner than if the wall or ceiling surfaces did not spread flame. When these materials are used, as in corridor ceilings, they permit people to be trapped in areas of buildings from which escape in case of fire would be otherwise possible.

These wall finishes have shown up in a good many notable fires, particularly in hotels, hospitals and nursing homes. Recently, a good many architectural offices have heeded the lessons of these notable fires. They are beginning to recognize that there are definite differences in rate of surface flame-spread characteristics in various wall finish materials. Still it is a very substantial area of ignorance.

Many of the cases of loss of life in homes have undoubtedly been caused by quick-burning wall finishes. The usual pattern of such fires is that the

fire starts small, gradually builds up heat in a room and suddenly flashes over the entire wall surface at a rate sufficient to prevent escape.

The wallboard industry in the United States has taken a constructive step by giving a flameproofing treatment on one side to some of the more combustible wallboards. This materially reduces the surface flame-spread hazard, but it does not eliminate the problem by any means.

There is a standard test by means of which wall finish materials may be rated. This involves a test on a 25-foot-long sample of a particular wall and finish assembly. This apparatus is described as a "tunnel" furnace. It is possible to ignite the sample at one end and note the rate of flame propagation and also the amount of smoke and the rate at which the material develops fuel for the fire.

Wallboards subjected to this test are rated on a scale where noncombustible material rates as zero and red oak boards rate as one hundred. Red oak boards are relatively safe. Some of the pine woods get up close to two hundred and most untreated cellulose board is over two hundred on this scale. Some plywoods are much higher.

The foregoing statement does not go into all the details. Those which are mentioned are simply by way of illustration of the fact that there are known factors about fire behavior of wall finishes which need not be ignored.

Areas of Unnecessary Ignorance

Perhaps the six areas of ignorance enumerated are enough to establish the fact that these areas do exist. There is a good book entitled *Fire in Buildings*, published by Adam & Charles Black in London in 1949 and circulated in the United States by D. Van Nostrand, which I recommend as a text in which some of the thoughts presented here are developed further. The authors are Eric L. Bird, Editor of the *Journal of the Royal Institute of British Architects*, and Stanley J. Docking, a city planner. These two architects learned about fire problems through wartime experience in the course of which they were assigned to study the fire effects of the bombing of English cities.

Comparing it with other subjects to which architects give attention these authors said; "Fire protection has been neglected; its principles are not generally understood; its practice is hardly taught at all." Architects who have taken the trouble to get a real acquaintance with the fire problems of building design generally support this conclusion. However, the limited sale of this very good book on the subject tends to prove that architects feel no great awareness of fire as a problem for them in building design.

Eventually, the content of courses in architectural and engineering schools must cover these areas of ignorance. This does not mean additional courses in fire protection. The crowded curricula of our schools mean extra courses are something for graduate work; existing courses in building design must identify fire as one of the factors to be dealt with and not simply ignored.

In the meantime, the National Fire Protection Association is working to reduce these areas of ignorance. We have enjoyed the assistance in this work of a number of distinguished architects. This has been very welcome even if, percentagewise, it has been a very small number of people from the profession.

Building Exits Code

Most of the NFPA standards are very helpful to architectural offices which have taken the trouble to find out about them. The Building Exits Code* should be particularly mentioned. This Code provides for public safety to life from fire and has been developed over a period

* Available in pamphlet form for $1.50 a copy. Also to be published in Volume III of the National Fire Codes, 1957 Edition, to be available in September 1957

dating from about 1911. The latest edition of the Building Exits Code is the Fourteenth, dated May 1957.

Particular stimulus was given to the Code by the Coconut Grove Night Club fire in Boston in 1942. In this case, the loss of 492 lives focused national attention on the importance of adequate exits and related fire safety features. Attention to exit matters was further stimulated by the series of hotel fires in 1946 — La Salle, Chicago, 61 dead, Winecoff, Atlanta, 119 dead, and others.

The Building Exits Code reflects a somewhat different approach to fire safety than does the conventional building code. It states requirements for life safety without specifying a single method of achieving safety if more than one method is possible. In other words, the Building Exits Code can be used by an architect as a basis for design work, and he will find that while meeting the provisions of the Code, he is given the utmost freedom to fit the particular solutions in with the other solutions of the particular building problem before him. I commend this Code to your attention.

As far as the NFPA is concerned, and like all our standards, the Building Exits Code is purely an advisory document. A number of states, however, have adopted the Code in law and a great many other federal, state and municipal agencies are using the Building Exits Code as a basis for determining the reasonableness of their requirements for situations which are not specifically covered by laws and regulations or for situations where the literal application of a particular law or regulation would involve an unnecessary expense or hardship.

Conclusion

The solution of many fire problems in building design must be done on the drawing board. This is a plea to architects and all others to bring their imagination and ingenuity to bear on these problems.

A Place for Old Folks to Live

By Chester I. Babcock, Manager
NFPA Fire Record Department

During the past 10 years 283 lives have been lost in 15 of the most notable nursing home fires. Considering the fact that there are only about 25,000 licensed nursing homes in the United States, this record of slaughter by fire places nursing homes in the unenviable position of number 1 in the list of unsafe places to live. Yet it is to these same nursing homes that an ever increasing number of our old people are turning for shelter. If these people are to have any assurance that they may spend the last years of their lives free from the continuous threat of death by fire it is up to us, now, to see that the proper steps are taken to convert the fire-trap nursing homes to safe places for old folks to live.

Two basic principles must be kept firmly in mind in any discussion of ways and means to improve the fire safety of homes for the aged. One is the universally recognized principle that sick and helpless people require legal protection against exploitation when their care must be entrusted to others. The second is that nursing homes are vital to the welfare of older people and must not be so regulated that their continued operation would be impossible unless exorbitant fees were charged.

During the past 50 years, fire protection, based on these two principles, has gradually been provided for hospitals,

Based on a talk presented by the author at the 61st NFPA Annual Meeting held in Los Angeles, Calif., May 20–24, 1957.

Photo by W. A. McDonnell

Photo No. 1. Cedar Grove Nursing Home, Hillsboro, Missouri. Fire: October 31, 1952. Reference: NFPA Quarterly, January 1953.

Wide World Photo

Photo No. 2. Madame Henri's Nursing Home, Pointe aux Trembles, Quebec. Fire: April 13, 1957. Reference: NFPA Fire News, May 1957.

mental institutions and orphanages through enactment of state and local regulations. Not so with homes for the aged, nursing homes and similar establishments catering to the needs of older people. These places in most sections of the country have been allowed to thrive and multiply without adequate fire safety regulation. Consequently, one of the most urgent problems confronting conscientious fire officials today is the correction of alarming life hazard conditions that are now prevalent in a large proportion of the nation's nursing homes.

What should be done and how? Principle No. 1 pointed to legislation as the only remedy. Principle No. 2 insisted that the legislation, while assuring adequate fire protection for the inhabitants of nursing homes, must not be so restrictive as to make the nursing home business unprofitable. To draft such legislation would be difficult were it not for the fact that a nationally recognized guide is available. This guide is the sections on nursing homes in the 1957 NFPA Building Exits Code.* Regulations based on the provisions of this Code will afford a reasonable degree of safety to nursing home occupants and will at the same time permit the nursing home operator to stay in business.

The Building Exits Code touches on all the factors that go to make up a fire-safe place for old folks to live. All are important and none should be omitted from legislation dealing with nursing home fire safety. The most important provisions of the Code dealing with nursing homes are: limitation of the amount of combustible material in nursing homes, proper exit facilities, automatic fire protection, hazard segregation and provision of trained attendants.

Limitation of Combustible Material

The provisions of the NFPA Building Exits Code are based primarily on the lessons learned from actual fire experience. It is because of this that we believe they are sound and do not hesitate to recommend them. What does the Code say about combustible materials? Throughout the sections on nursing homes there are several provisions that discourage the use of combustible materials and offer incentives to use noncombustible building materials and contents. Here are a few cases from an endless volume of fire experience to justify these provisions.

*NFPA No. 101, May 1957, available from the NFPA Publications Service Dept. for $1.50 a copy. Also to be published in the 1957 Edition of Vol. III of the National Fire Codes (available in Sept. 1957).

Photo No. 1 shows the Cedar Grove Nursing Home of Hillsboro, Missouri where 20 persons lost their lives in 1952. This fire is one of several in which highly combustible interior finish was an important factor responsible for loss of life. In this case, as is true of all fatal nursing home fires, there were several notable weaknesses in the provisions for life safety from fire, but in this particular fire the combustibility of the interior finish appeared to be the principal reason that the fire spread so fast that the trapped aged occupants could not be rescued.

Had the light fixture on the first story linen room where the fire started been installed properly the fire would not have occurred and had the stairway extending from the first to the third story been enclosed the fire would not have spread vertically. The light fixture installation, however, was substandard and the stairway was open. Consequently, since the linen room and adjacent hallway were lined with combustible fibreboard, fire originating at the light fixture spread along the walls so rapidly that of the 70 occupants 20 were killed and 37 were injured.

This fire, the fire in Garfield Heights, Ohio in 1946 that took 14 lives and the Largo, Florida fire of 1953 which killed 33 are ample justification for the sections of the Building Exits Code which require that walls and ceilings of corridors, passageways and stairways in existing buildings shall not have a flame spread of greater than 75 as determined by the tunnel test, and not greater than 20 in new buildings.

Another important section of the Code discourages the use of combustible buildings by prohibiting the continued operation of an existing nursing home unless protected by automatic sprinklers or an automatic fire detection system. If patients are to be housed above the first floor of a combustible building, the building must be completely sprinklered. The Hillsboro fire is a good example of the logic of this provision. Had this building been sprinklered, or, as an alternative, had patient areas been restricted to the first floor, and had an automatic detection system been installed to assure prompt discovery, it is probable that all patients could have been rescued.

At Pointe aux Trembles, Quebec, a Montreal suburb, seventeen persons were killed in a nursing home fire last April (see Photo No. 2). Although this 200-year-old building had 2-foot-thick outside walls its interior construction was combustible and it had subsequently been surrounded by a 1-story combustible addition. The 10 aged occupants to escape were in the first story of the unsprinklered building when the fire occurred; those trapped were in the attic.

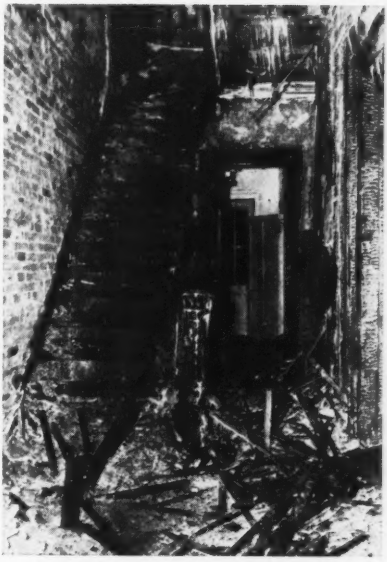


Photo No. 3. Niles Street Convalescent Hospital, Hartford, Conn. Fire: December 24, 1945. Reference: NFPA Quarterly, Jan. 1946.

The fire record also shows that the combustibility of the contents is an important contributing factor in nursing home fire disasters. At Hartford, Connecticut 19 persons were killed and 35 were injured on December 24, 1945. The fire originated on cotton batting at the base of a Christmas tree in a first floor office off the corridor shown in Photo No. 3. Telephone wires burned, delaying fire department notification, and when the employee who discovered the fire found that he could not operate a fire extinguisher he became panicky and ran from the office leaving the door open. Fire followed him out of the room and spread up an adjacent open stairway to upper stories.

Eight of the ten patients in the nursing home at Watervliet, Michigan, shown in Photo No. 4, lost their lives when fire swept

through the unsprinklered 2-story wooden home in 1954. The fire originated in a glassed-in sleeping porch off the first floor where combustible draperies had been hung in front of all windows, and a large curtain had been suspended from the ceiling to divide the porch into two sleeping areas. The fire broke out when one of the curtains came in contact with a portable electric heater.

Lack of training of attendants in the proper procedure to follow when fire broke out was an important factor in this disaster as was also an open stairway and the lack of sprinklers, but the point to be emphasized here is that the combustible curtains were responsible for the outbreak of the fire and its rapid involvement of the sleeping porch.

So it is not surprising that a section in the Building Exits Code requires that all combustible floor coverings, curtains and decorations be rendered and maintained flame-resistant and prohibits the use of Christmas trees and other decorative greens containing pitch or resin.

Exit Facilities

So much for combustible building materials and contents in nursing homes. Details of adequate exit facilities have also received considerable attention in the sections on nursing homes in the 1957 Building Exits Code. Of particular importance is the requirement that all stairways be enclosed to protect the stairway as a means of exit and to prevent the spread of fire and smoke up the stairway from floor to floor. In those existing buildings where it is impractical to enclose a stairway completely, the Code permits partitions with self-closing doors to cut off the stairways at floor levels. At first thought this alternate to complete stairway enclosure may appear to represent a drastic compromise at the expense of the life safety of the occupants since a partition at the head of the stairway will not prevent the stairway from being blocked by fire, heat and smoke. After reviewing the records of several nursing home disasters and witnessing at first hand the physical and mental conditions of the majority of the people customarily found in nursing homes, it becomes obvious that their life safety depends primarily on steps to keep the fire from the patients rather than on facilities for removing the patients from the fire.

The importance and desirability of the best exit facilities possible for nursing homes should not be minimized.

A P Wirephoto

Photo No. 4. Shimer Convalescent Home, Watervliet, Mich. Fire: February 19, 1954. Reference: NFPA Fire News, April 1954.

Press Association

Photo No. 5. St. John's Hull Home, St. John's, Newfoundland. Fire: February 10, 1948. Reference: NFPA Fire News, March 1948.

Inadequate exits have been a factor in almost every fatal nursing home fire but it must be remembered that many nursing homes are converted combustible dwellings where complete stairway enclosures may be impractical. It must also be kept in mind that we are not providing exits for a college dormitory or a hotel where the occupants are usually physically and mentally able.

One fire that always comes to mind when inadequate exits are discussed occurred at the home for the aged at St. Johns, Newfoundland in 1948 (see Photo No. 5). Thirty-three of the occupants lost their lives because a single open stairway was the only way out of the upper stories. The fire started at a defective oil range in the second story kitchen, and by the time firemen had arrived, had spread up the open stairs and into many rooms on the upper floor. Only a few persons were alive to be rescued by firemen. Three had jumped and were killed.

Photo No. 6 shows the fire in Montreal in 1951 in which 28 aged women and six employees lost their lives. The fire originated in a second story corridor, spread through the corridor to an open stairway and then went up the stairway and trapped elderly victims and some of the attendants in rooms in the third, fourth and fifth stories. Many fire protection weaknesses combined to cause this disaster including combustible interior finish in corridors and lack of sprinklers, but despite these conditions, it is probable that the women in the upper stories could have reached safety or at least would have still been alive to be rescued over ladders when firemen arrived had the stairways been enclosed.

The fire shown in Photo No. 7 could be used as an example of just about any fire safety weakness which can be named. It is the Warrenton, Missouri nursing home fire of last February in which 72 aged occupants lost their lives. Details of the fire were published in the March 1957 issue of the NFPA "Fire News". In the 2-story Annex, where the fire started, a single open stairway discharging into the first story was the only way out of the second story. In the communicating 2-story Main Building to which fire and smoke quickly spread, two open stairways discharging into the first story were the only exits for those in the second story. Because of the open hallways and

David Bier

Photo No. 6. Hospice St. Cunegonde, Montreal, Quebec. Fire: June 15, 1951. Reference: NFPA Quarterly, July 1951.

St. Louis Post-Dispatch

Photo No. 7. Katie Jane Nursing Home, Warrenton, Missouri. Fire: February 17, 1957. Reference: NFPA Fire News, March 1957.

Acme

Photo No. 8. Walker Convalescent Home, near Amarillo, Texas. Fire: December 22, 1950. Reference: NFPA Fire News, February 1951 and NFPA Quarterly, January 1951.

stairs the Annex and Main Building comprised one large fire area.

The fire when first seen was at ceiling level in the first story of the Annex. Almost immediately the single stairway in the Annex became impassable and within a few minutes smoke and heat had made stairways and corridors in the communicating Main Building unusable.

Regulations for nursing home fire safety have recently been adopted in Missouri that include all principal recommendations of the Building Exits Code.

Automatic Sprinklers

As previously mentioned, the 1957 NFPA Building Exits Code recommends sprinklers in all nursing homes. It requires them in existing nursing homes if patients are to be housed above the first story of a combustible building, or above the second story of buildings of at least 1-hour but less than 2-hour construction. Sprinkler requirements for new nursing homes are much more stringent. For example, sprinklers are required in a 1-story building of protected ordinary construction. Buildings of less fire resistance are not permitted, sprinklered or otherwise.

Automatic sprinklers, properly installed and maintained, are the most effective of any of the various safeguards against loss of life by fire. That statement is substantiated by the nursing home fire record which shows that there has never been a fatality in a completely sprinklered nursing home. In answer to any objection that is sometimes conjured up by those opposing sprinkler protection, there is not one instance in our files of over 100,000 sprinklered fires where sprinkler discharge has in any way contributed to panic, caused an occupant to come down with pneumonia or caused any other discomfort not commonly associated with taking a bath. For every nursing home fire fatality in an unsprinklered building, hundreds of examples of inmates that are alive today because of sprinklers can be cited.

Several references have already been made to the absence of sprinkler protection as an important reason for these fatal nursing home fires. Would the 20 deaths have occurred at Hillsboro, Missouri had the linen room where the fire started been sprinklered? What

would the outcome have been in the Hartford fire had sprinklers been installed in the office above the Christmas tree?

Photo No. 8 shows the remains of a convalescent home near Amarillo, Texas after it was destroyed by fire in 1950. Ten bedridden patients died when fire that originated in the heater room flashed through heating ducts and burst out into all rooms simultaneously. Better exits would not have helped these people, but a sprinkler system would.

Accidental ignition of a window curtain by an elderly occupant was the cause of fire that took the lives of six men in 1953 at the Billings, Montana nursing home shown in Photo No. 9. Based on the life safety record of sprinklers it is safe to say that these men would not have died had the home been sprinklered.

At Puxico, Missouri, last July, ten aged patients, the home operator and a small boy lost their lives in the fire shown in Photo No. 10. The blaze occurred during the night while everyone was asleep in the second story and attic of the unsprinklered wooden building. The fire started in an upholstered couch in the first story living room, spread along the combustible fibreboard wall and ceiling finish and up an open stairway. When discovered by an outsider the fire had made so much headway that it was impossible to rescue the operator. Would these people have died had the building been sprinklered?

Automatic Fire Alarms

In certain existing buildings the Building Exits Code permits the installation of an automatic fire detection system in lieu of sprinklers. Undoubtedly no one on the committee that drafted the Code is under the illusion that an automatic device that discovers a fire provides as high a degree of life safety as a device that discovers a fire and then puts it out. But the committee undoubtedly did foresee that installation of a sprinkler system would place an unbearable financial burden on some operators of existing small homes and consequently permitted the installation of an automatic fire alarm system instead of sprinklers. In such cases the reduction in degree of safety afforded patients was offset by limiting patients to the first floor in existing combustible buildings and to the first two floors of

Photo No. 9. Gallagher Nursing Home, Billings, Montana. Fire: January 25, 1953. Reference: NFPA Fire News, March 1953.

Bob Standard

Photo No. 10. Reagan Nursing Home, Puxico, Missouri. Fire: July 30, 1956. Reference: NFPA Fire News, September 1956.

Press Association

Photo No. 11. Catholic Home for the Aged, Garfield Heights, Ohio. Fire: February 2, 1946. Reference: NFPA Quarterly, April 1946.

United Press Photo

Photo No. 12. Littlefield's Nursing Home, near Largo, Florida. Fire: March 29, 1953. Reference: NFPA Quarterly, April 1953.

existing buildings of at least 1-hour but less than 2-hour construction. This compromise to satisfy the objection to sprinklers by the small operators on the grounds of expense does not violate either of the basic principles: it recognizes the necessity of the continued operation of the small nursing homes and provides the needed protection of the aged against exploitation.

Under no condition does the Code permit the substitution of an automatic fire detection system for sprinklers in new nursing homes.

Fourteen occupants of a nursing home lost their lives in a fire at Garfield Heights, Ohio in 1946. The building is shown in Photo No. 11. Looking at this building from the outside and noting that it was only one story high and had several wide exits, one might be excused for thinking that the occupants had nothing to fear from fire.

Inside, however, the picture changed since the large undivided attic, the highly combustible interior finish and the absence of automatic protection suggested several ways in which fire could endanger the occupants. This tragic fire started in the attic and since there was no automatic means provided for discovering fire, it developed unbeknown to the occupants until it burst through the ceiling and flashed over the combustible interior.

Thirty-two aged occupants and an attendant lost their lives when fire destroyed the 1-story wooden nursing home shown in Photo No. 12 near Largo, Florida in 1953. Various fire safety weaknesses were responsible for this terrible loss of life, including highly combustible interior finish. No attendant was awake and on duty to discover the fire when it was still small and since there was no automatic fire detection system the fire burned undetected until discovered by an elderly occupant at 3:15 A.M. Lights had already been put out of order by the fire and smoke was rapidly filling the building.

After wasting valuable minutes discharging fire extinguishers in the general direction of flames in the kitchen, the owners rushed through the building opening doors and shouting to patients to get out. But the occupants were typical of those in nursing homes — old, feeble and, in some instances, without their full mental faculties. On being awakened from a sound sleep they reacted in a stunned and uncomprehending manner and instead of proceeding into the smoke-filled corridor or climbing out of a window they stayed in their beds! A few

Photo No. 13. Wood County Infirmary, Nicolette, W. Virginia. Fire: February 26, 1950. Reference: NFPA Fire News, May 1950.

San Francisco Call-Bulletin

Photo No. 14. Little Sisters of the Poor Home for the Aged, San Francisco, California. Fire: April 15, 1952. Reference: NFPA Fire News, June 1952.

Wide World Photo

Photo No. 15. McClary Convalescent Home, Hoquiam, Washington. Fire: January 30, 1951. Reference: NFPA Fire News, March 1951.

bedridden patients were carried out but very little assistance could be offered the others before wind-swept flames raced through the highly combustible building.

Segregation of Hazardous Areas

Fire experience has shown that certain areas of buildings such as furnace rooms, carpenter shops and paint shops are particularly susceptible to fire and it is for this reason that the Building Exits Code requires segregation of boiler and heater rooms by construction of at least 1-hour resistance and makes the same requirement for repair shops and other hazardous areas if they are not protected by automatic sprinklers. In existing buildings an automatic fire detection system may be provided in lieu of sprinklers.

Photo No. 13 shows the scene of one fire from the many that could be used to justify these requirements. The five deaths that occurred at this nursing home at Nicollette, West Virginia in 1950 would not have occurred had areas known to be fire breeders been cut off.

This February fire started near the furnace in the basement when heat from the furnace and flue pipe ignited the combustible walls and ceiling. Flames spread laterally through the unsprinklered basement and up an open stairway before the home superintendent and his wife were awakened by smoke at 2:20 A.M. The 34 who escaped made their way to safety down outside metal stairways or were rescued over ladders.

One section of the Code requires firestopping of walls, partitions and all other concealed openings between the basement and first floor of existing nursing homes. Why? The fire shown in Photo No. 14 in a San Francisco nursing home in 1952 will answer the question. This home had to be evacuated shortly after midnight because fire that flared up from a pool of oil near the oil burner in the boiler room, entered nonfirestopped concealed wall spaces and spread vertically within walls of the 5-story building.

Although sprinklers gave the alarm and extinguished the fire in the boiler room, they had no effect on flames that had entered unsprinklered wall spaces. Had the relatively simple and inexpensive procedure been followed of firestopping the walls at the basement ceiling or if the boiler room had been cut off from the rest of the building by construction of 1-hour fire resistance the fire would have been confined to and extinguished in the boiler room.

At Hoquiam, Washington, fire that originated in a laundry room spread up an open laundry chute to the second story hallway (See Photo No. 15). Twenty-one aged men and women were trapped and lost their lives. This fire is ample justification for another provision in the Building Exits Code relating to segregation of hazards, namely that verti-

cal openings, such as laundry chutes, must be totally enclosed or sprinklered.

Attendants

The Building Exits Code requires one competent and trained attendant on duty and one stand-by in every nursing home. In a fire emergency two attendants would not be sufficient to evacuate 25 elderly persons during the first few minutes and we would much prefer to see 10 or 12 competent and well-trained people on duty. Such a requirement, if enforced, would immediately force nursing homes by the thousands to close up — a situation which cannot be allowed to develop. So the alternative philosophy, which must have guided the drafters of the nursing home sections of the 1957 Building Exits Code, is to proceed from the standpoint that the safety of the occupants of nursing homes must depend primarily on prompt discovery and control of fire rather than prompt evacuation. Of far greater importance than the number of attendants present is their competence and training.

In 1954 seven of ten patients in the nursing home near Kincaid, Kansas shown in Photo No. 16 lost their lives. The owner and his wife were away at the time and had left the home in the care of three attendants, none of whom had been instructed as to what to do in case of fire. One of the three had been on the job only a day and another only a week. No one was required to stay awake and on duty during the night.

The fire started in the first floor recreation room and was not discovered until an attendant on the second floor was awakened by smoke. There was still time to get people out through an emergency exit from the second story but apparently none of the attendants made any attempt to do this and without someone to guide them, the old people, although all were able to walk, did exactly as their counterparts at Largo, Florida — stayed in their beds.

At Council Bluffs, Iowa, where 15 of the 30 patients in a home for the aged died last February, the ratio of attendants to patients was one to three (see Photo No. 17). Surely there should have been no loss of life here if number of attendants was a critical factor.

Much more critical was the lack of training of the ten attendants in what to do in case of fire. Perhaps the fact that seven of the ten had been hired on a probationary basis from a school for feeble minded had something to do with their lack of training.

United Press Photo

Photo No. 16. Kincaid Nursing Home, near Kincaid, Kansas. Fire: September 17, 1954. Reference: NFPA Fire News, October, 1954.

Council Bluffs Fire Department

Photo No. 17. Council Bluffs Convalescent Home, Council Bluffs, Iowa. Fire: February 13, 1957. Reference: NFPA Fire News, March 1957.

The fire started in the first story at noontime and was discovered promptly. It is almost certain that not a life would have been lost had the attendants proceeded to remove the first floor patients in a systematic manner and had they kept the door at the head of the stairs to the second story shut. These steps were not taken with the result that several first floor and most of the second story patients were trapped and both stories were enveloped by smoke and fire when the first fire company arrived.

From this fire it should not be inferred that the practical answer for fire safety in existing nursing homes is a large number of well-trained attendants. Nothing could be more impractical. The practical answer is spelled out in the Building Exits Code, — a minimum of two well-trained and competent attendants and patients confined to the first story unless the building is completely sprinklered.

Some Safe Places to Live

Exploitation of the aged by those in the business of providing places for old folks to live has been pointed out as being prevalent throughout a large part of the United States and Canada. The fires cited in this article should leave no doubt as to the validity of that assertion. But there are some areas where a real effort has been made to provide safe places for old folks to live. Here are four outstanding examples.

California is in the vanguard when it comes to providing safe places for its old folks to live. The state's regulations as spelled out in Title 19 of the California Administrative Code are predicated on the fact that the height and fire-resistive qualities of the building have a direct bearing on the safety of the occupants. For example, patients cannot be housed above the first floor of combustible buildings or above the second floor of buildings of 1-hour fire resistance. When additional protection, such as a sprinkler system, heat-activated fire alarm system, enclosed stairways and vertical shafts are provided the limitations may be relaxed by

the inspection authority. Since January 1, 1957 every nursing home housing six or more patients must be protected by a listed and approved automatic fire detection system unless the building is of Class I or Class II fire-resistive construction or unless it is completely sprinklered.

The Georgia State Fire Law of 1949 required the Georgia State Fire Marshal to provide adequate fire safety regulations throughout the state. The Fire Marshal has adopted the NFPA Building Exits Code as his regulations. Since the Georgia State Fire Law was adopted there have been no fire losses in a nursing or convalescent home in Georgia.

In Louisiana complete sprinkler protection is required in all combustible nursing homes. Records of the past year and a half in Louisiana show that there have been three fires in sprinklered nursing homes and that in each instance sprinklers extinguished the fire and no one was injured.

Perhaps, you'd be interested in one city's efforts to protect the occupants of its nursing homes. Since 1954 in Lexington, Kentucky, patients have not been permitted above the first floor of a combustible building unless the building is completely sprinklered.

California, Georgia, Louisiana, and Lexington, Kentucky — these are four examples of what has and can be done to provide old folks with a safe place to live. It is not coincidence that none of these four were represented in the list of fatal nursing home fires mentioned in this article. The people of these three states and one city have accepted their responsibility to protect the aged occupants of nursing homes from death by fire. Have you?

The Problem of Caring for the Aged

By Howard W. Naulty

Owner-Operator, East Aurora Nursing Home, East Aurora, N. Y.

The problem of caring for the aged is not a new one. President Eisenhower recognized it in his speech to Congress in January 1953. Many State legislatures have been studying the situation for some time. The total problem entails psychological, sociological, financial, housing, medical and nursing care aspects. All these aspects cannot be discussed within the framework of this article. It is perhaps appropriate, however, to discuss some of these problems to see how they affect fire safety from a practical point of view as seen by a nursing home operator.

How serious is this problem of care for the aged? According to figures prepared by the U. S. Department of Health, Welfare and Education, in 1950 there were approximately 12,000,000 people in the U. S. above the age of 70; by 1960 it is predicted that this figure will be in the order of 16,000,000. This group of elderly persons can be subdivided into three groups.

Needs of the Aged Vary

The first and by far the largest of these groups consists of those persons who have reached advanced age with a minimum of infirmities and are therefore self-sufficient. Since they can be cared for at home, they present no problems.

In the second group are those persons who have no serious ailments or disabilities but yet require some assistance and supervision to carry on their daily activities.

The third group consists of those folks inflicted with the problems of infirmity such as senility and associated sclerotic problems plus such complications as diabetes, the various diseases of the heart, cancer, loss of sight, and loss of body activity through paralysis.

Geriatric specialists are agreed that the members of the second group should be placed in what might be called "supervised boarding homes" where they receive patient and sympathetic care in an atmosphere similar to that in which they have lived all their lives. If they are placed in institutions containing members of the third group — the seriously ill or senile patients — they have a tendency to become morbid. Therefore, it is essential that they be placed in buildings designed for their specific care. Their greatest need is sustainment of the feeling of being wanted by their friends and relatives and being able to be of service to society. The problem then becomes one of occupational therapy to fulfill those requirements that maintain the morale of these folks.

The patients in the third group, while similar to the previous group in that they also require a home-like atmosphere, need hospital type facilities. These people are usually bedfast, or, at best, are able to sit up in a chair for only short periods of time. They require hospital beds, provisions to eat their meals in their rooms or in bed, and need all of the specific precautions required for the care of the incontinent, including bedpan storage and special plumbing facilities for bedpan sterilization. Oxygen, intravenous equipment and, in some cases, blood plasma are frequently required. Such people require varying degrees of medical and nursing care.

Based on a paper presented by the author at the 61st NFPA Annual Meeting held in Los Angeles, Calif., May 20-24, 1957. Mr. Naulty is also Director of Research at the Amherst Manufacturing Company.

Origin of Nursing Homes

In order to discuss the problem presented by nursing homes intelligently, it is essential to understand the origin of nursing homes in general. Early nursing homes were started by either a widow who found herself with a large home and very little income, or by the so-called nurse's aid (or the untrained, unlicensed, pseudo-practical nurse) who had visions of a large income for very little effort. Unfortunately, it turned out that there was no great bonanza in the nursing home business. Before very long, these operators found that they had to put on more help, thereby reducing their income, or they simply allowed the patients to suffer for lack of more adequate supervision.

The prices established by these early operators did not warrant adequate staffs. The income was largely from welfare patients and was not sufficient to provide improvement in the structure or adequate protection for the patients. Further, there was no state or municipal regulation of standards for these buildings and the reputation they enjoyed was not a good one. These statements were not true of all the early nursing homes, but because some operators were willing to accept patients at an unrealistically low rate, the standards of the entire industry were reduced accordingly.

New and Existing Homes

It is important to make a distinction between new and existing nursing homes when considering the adequacy of their fire safety. There would be very little problem in operating a new nursing home constructed in accordance with the 1957 Edition of NFPA Building Exits Code (NFPA No. 101).* I believe that all *new* nursing homes should be constructed of what the man in the street likes to call "fireproof material" and built in such a way that any fire that might originate in bedding, draperies or stored supplies could be contained within the room in which it originates by the fire resistance of the structural assemblies. In addition, I believe that all such buildings should have a *complete* sprinkler system. If the walls, floor, ceiling and doors of a given room cannot burn, then the only items that can burn would be bed linen, pillows, mattresses, clothing, furniture, etc. With so few combustibles, sprinklers should be able to extinguish so quickly such fires that do start that they could not spread beyond the area of origin. Under these conditions, there would be no need to evacuate the patients in the rooms not involved and this would reduce to a minimum the number of patients exposed to the fire, the weather and to the confusion and panic of evacuation.

The Economic Problem

Today, when a patient enters a nursing home he has every right to expect and receive: (1). A comfortable, uncrowded homelike atmosphere, modern in style, light, cheerful and pleasant; (2). Food equivalent to that he would receive in his own home, consistent with his dietary requirements; (3). Sympathetic and patient medical and nursing care equal to, or better than that received in the hospital; and (4). 24-hour lodging. For this care, the public expects to pay as little as possible. I can cite cases of certain counties of one of our largest states where the amount paid for welfare patients is considerably less than $4.00 a day. In fact, with the exception of New York City, the highest rate paid in any county in New York State is less than $6.00 a day. Yet, the public thinks nothing of paying $6.00 to $10.00 per night in a motel which is very similar to a nursing home in the cost of the building and its furnishings.

The motel business is highly competitive. The rates they charge represent the minimum possible figure on which they can operate. Two or three people

*Available in pamphlet form at $1.50 a copy. To be published in Volume III of the National Fire Codes, available in September, 1957.

can staff a building capable of accommodating forty or fifty guests each night. At most they require only one change of linen per bed per day. There is no food to purchase, store or prepare.

If I may be pardoned a personal reference, my wife and I operate a building having a capacity of 16 patients. In addition to my wife, we have on our staff eight licensed practical nurses or nurse's aides, a cook, a cleaning woman, and a part-time secretary. In the case of our Nursing home, it is not unusual to have four or five complete changes of bed linen for ten or twelve of our beds each and every day. We must provide high protein, salt-free, and sugar-free meals in addition to the regular house diet. If you feel that $6.00 a day is a reasonable rate for a bed in a motel, how much more do you think it should cost for all the other services and facilities in a nursing home?

All nursing homes are not "snake-pits," but even the most conscientious nursing home operator could not operate for long if his books contained nothing but red ink. The income now received barely provides for the week-to-week operating costs and leaves little or nothing for amortization or improvement of the building itself. Therefore, many buildings housing nursing homes have deteriorated and there are little or no funds available for the improvements necessary for safety to life. Do not interpret this as a plea to justify the conditions that exist in nursing homes today; rather, it is a statement of simple fact that might explain *why* the conditions exist.

Geriatric Nurses Needed

A condition that is already a serious problem, but one that will become much worse before it begins to improve is that of attendants or help for nursing home staffs. The registered nurse has reached the level of professional standing that places her above the attendant services required in nursing homes. No longer will a registered nurse carry a bedpan, mop under a bed, spend extra time combing a patient's hair or doing the many little things that make them comfortable. I cannot criticize registered nurses for assuming this professional standing. There is a real need for their skills and they should apply themselves where they can do the most good.

However, this leaves the nursing home operator dependent on licensed practical nurses and nurse's aides. There is a definite shortage of licensed practical nurses. The licensing requirements of most states have made it impossible for anyone to become a licensed practical nurse except by taking a year or more of daytime study. This precludes the possibility of tapping one of the largest sources of the licensed practical nurses, the lady in her late thirties or early forties who suddenly finds she must support herself. She is the person best suited mentally to care for the aged and probably could make a very good practical nurse but because she has a family, she cannot spend the time required to get a license before beginning to earn a salary. Since she cannot receive her practical nurse's license, this relegates her to the realm of a nurse's aide. There is little income in a nurse's aide's position to attract these women to the profession.

The answer to this problem is two-fold: First, there should be a special category of nurses, known as geriatric nurses who would need to know little or nothing about operating room techniques, but who should be masters of the art of making the patient comfortable and in recognizing the symptoms of the infirmities of age and its associated ailments. Secondly, a program of in-work upgrading would induce more girls to enter the nursing profession. The nursing profession is the only profession I know of in which it is not possible for a person to start out as a nurse's aide and through extensive night-time study, coupled with on-the-job training, be able to elevate herself up through the various grades of professional status. Any suggestion of this nature is opposed

bitterly by the various nurse's associations but I believe that some day such a provision will be forced upon them.

The salary of nurses and nurse's aides is far too low in comparison to general industry. Again we find the stumbling block of finances. If we were to pay the nurses on a wage scale comparable to industry the cost of average nursing home care would be very nearly double that of today's prices.

In making the foregoing statements I am neither "crying the blues" nor trying to present a case for personal gain. It has always been my opinion that there is no substitute for quality and in any industry there is always room at the top for quality. It merely means that the country is faced with a very serious problem. The fact must be recognized that the average family is not capable of caring for an older person as he or she should be cared for, but, at the same time, the average family cannot afford to pay for adequate nursing care for their aged members over a prolonged period of time.

There is probably no nursing home owner in the country who has not attempted to expand the facilities of his nursing home at one time or another. We all have in our mind what we consider the ideal nursing home, but the problem of financing such an expansion is almost an impossible one. Because a nursing home facility is a single purpose building, banks and financing houses are not interested in lending money for this type of operation. I am sure that private enterprise would be willing to take the risk of financing its own expansion provided loans could be obtained from commercial sources and I believe that banks might be willing to make such loans if the government would reinsure the loan somewhat similar to the reinsurance program for veterans' mortgages.

Sprinklers Needed in All Homes

Many *cities* are requiring existing nursing homes to be equipped with automatic sprinkler systems while in *rural or country areas*, because of the difficulty in obtaining sufficient water and proper pressures, there is a tendency to permit fire detection systems in lieu of sprinklers. In my opinion, the use of fire detection equipment is the direct opposite of good judgment in the interests of life safety in these rural homes. If it is proper that nursing homes not located within reach of municipal water supplies need be protected only with a fire detection system because of the prohibitive cost of sprinklers, I contend that a lesser value is thereby being placed on the lives of the patients housed in these rural homes. Furthermore, homes located in the city are usually close to a fire hydrant and have available well-manned fire fighting apparatus on short order. Homes located in the country do not have available such efficient public water supplies and fire department facilities in most cases and some are dependent on wells of questionable value or perhaps a pressure tank of 50 to 100 gallons in the basement. The question arises under these latter conditions what good it does for the operator of a home to be notified that he has a fire if he has no way to fight it. Obviously, the life of a patient in a rural nursing home is worth just as much as the life of a patient in a city nursing home and he is entitled to the same protection.

In the January 1956 NFPA "Quarterly" an article entitled "Sprinklers Beyond the Water Mains"* stressed the simplicity and low cost of installing sprinkler systems in buildings beyond the reach of municipal water systems. Of the thirteen buildings shown in the photographs in this article, only one of them is a home for the aged, the majority being country or resort clubs. It seems ironic that country club property is considered more valuable than the lives of our aged loved ones.

*Available in separate pamphlet form, identified as NFPA Q49-6, twenty-five cents a copy.

With sprinkler protection the concept of containment of fire is as applicable in existing nursing homes as it is in new construction. The damage caused by the fire in a less fire-resistant existing nursing home may be a little more extensive than would occur in a new fire-resistant home but the records are clear that where adequate sprinkler protection is provided, loss of life and personal injury by fire has been exceptionally low.

Recommendations

It is very difficult to discuss the problem of caring for the aged on the basis of fire prevention or fire protection alone because there are relatively few problems that cannot be overcome with money and this problem falls directly into the lap of you, the consuming public, who buy your nursing home care on the basis of cost rather than quality. However, I would like to leave a few constructive recommendations for your consideration.

1. Every state in the union must adopt an intelligent standard for the construction and operation of nursing homes and I know of none better than the provisions of the 1957 NFPA Building Exits Code*. Once this standard is adopted it must be enforced rigidly by an adequate staff of educated and qualified personnel. The operation and regulation of nursing homes must be removed from any hint of political control.

2. Every nursing home now in existence in the country, without exception to locale or available water supply, must be required to install an adequate sprinkler system and with all due respect to the fine people who manufacture them, I would prohibit the use of a fire detector system as a substitute for a sprinkler system.

*Available in pamphlet form at $1.50 a copy. To be published in Volume III of the National Fire Codes, available in September 1957.

3. There should be no minimum limit on the number of patients to classify a nursing home. Wherever any patient or person is cared for and makes payment for that care, whether it be monetary or payment in kind, that patient is entitled to all the sanitary and safety to life protection that is required of any nursing home. By establishing a minimum number of patients and to use this minimum as a means of defining a nursing home operation, "bootleg" operations result, in which case there is no method of making sanitary and safety inspections and therefore the patients do not have the protection which they have in established homes.

4. The problem of greatest concern to all nursing home operators is that of smoking on the part of patients and staff. As much as we would desire it, it is not possible to prohibit all smoking. Many operators have established the rule that a patient may smoke only under the constant supervision of an attendant or some member of his or her family. The staff may only smoke during meals or at such times when they go off duty to some designated area. Such rules must be very emphatically enforced to be effective.

5. There should be no requirement for loud fire alarm gongs on the outside of nursing homes. Sprinkler systems in homes situated within city limits should be connected with the local fire alarm system or a central station fire alarm service. Nursing homes in the country where there is no local fire alarm system would derive no benefit from an alarm gong on the outside of the building beyond the hearing of a sufficient number of individuals to make such a gong purposeful. Such gongs are important in large buildings (i.e. warehouses, stores and office buildings) which are unattended at night but in the case of nursing homes, they only serve to instill fear in the hearts of all patients within their hearing, whether or not they are in real jeopardy. Instead of a loud gong there should be some non-panic causing internal alarm such as a

buzzer or light signal to notify the staff of the existence of a fire.

6. According to the best authorities, the cost of building hospital facilities varies from $20,000 to $30,000 a bed, while the cost of nursing home facilities is approximately $8,000 per bed. I would suggest then that if the funds now allocated for hospital use were used to build nursing home facilities it would be possible to build approximately three times the capacity in nursing homes with the same dollar value. By removing from the hospital and placing in a nursing home all patients who could be cared for in the nursing home we could very nearly double the number of beds available to the critically ill in existing hospital facilities, and at the same time triple the number of beds available for the care of the aged at no extra cost. For example, suppose a certain hospital with a capacity of 150 beds has been approved by the government for a 20-bed expansion program. Using the middle value of $25,000 per bed, the new building will require $500,000. This $500,000 would provide 62.5 nursing home beds, 20 of which could be occupied by non-critical patients from the hospital leaving 42 beds for the geriatric patients, thus increasing the hospital service and the nursing facilities simultaneously. Further, if the money could be used as a reinsurance fund to guarantee private loans, the money would not be lost to the government; it could be kept in a revolving fund for such buildings or it could be returned to the taxpayers each year as the private loans are repaid. With such a setup we could go a long way toward solving both the hospital and the care of the aged problems and at no additional cost to the taxpayer, which is almost like eating one's cake and having it too.

Cities Service Company

A view of the New Jersey Turnpike (reaching to the top of the photo) where it is crossed by the Garden State Parkway (the horizontal highway in the foreground) in a rural area.

Superhighway Fire Protection

By Herbert R. Bogardus, Manager, Technical Division

Fire Insurance Rating Organization of New Jersey

It is obvious that our present-day economy and prosperity are so dependent on adequate transportation that we must constantly devote our efforts and talents to the expansion of these facilities. Highway construction will be greatly accelerated, at least during the next fifteen years under the Federal Highway Program. Such progress carries with it the responsibility for providing adequate fire protection along these public thoroughfares. Many of us, who are closely associated with fire safety, feel that this phase of highway planning has received only casual consideration, with the result that frequently emergency service and communication facilities have proved to be inadequate or nonexistent.

Scope of Problem

Superhighways and accessory structures present two major fire protection problems. One problem concerns the protection which should be provided for the vehicles using the highways, to safeguard the lives and property which such vehicles transport. The second problem concerns the protection of permanent installations operated by or in conjunction with the facilities. Protection to life must, in all cases, merit primary consideration, while protection to property becomes of major importance by reason of the ever increasing value of commodities being transported by motor vehicles. Properties adjacent to bridge approaches and elevated structures may present a third problem in that they should be protected in those instances where vehicle fires could result in serious exposures.

Based on a talk by the author presented at the 61st NFPA Annual Meeting held in Los Angeles, Calif., May 20–24, 1957.

Many of the problems are typical of those found in our municipalities and protection may be provided by established conventional means. However, superhighways through rural areas are, in many cases, remote from municipal fire departments and limited access to the highways and accessory structures frequently precludes the prompt response of municipal apparatus and equipment. On such highways, the problems are complicated by the lack of adequate communication facilities for the reporting of emergency conditions and the lack of means for warning approaching vehicle operators of emergencies, hazardous conditions, or visibility limitations.

Basic Problem Areas

Protection to service areas, interchange toll booths, and structures used for administration, law enforcement and maintenance, present problems similar to those encountered in municipal jurisdictions, except that buildings are frequently isolated and remotely located from existing fire protection. Protection to life and property transported by vehicles is considerably more complicated in that the location of emergencies cannot be predetermined and may occur at any point, or simultaneously at several points, along the course of any facility. Fire emergencies that may be anticipated range from incipient fires in passenger vehicles, with no threat to human life, to major accidents, involving loaded buses, or trucks carrying flammable liquids or other hazardous cargoes. Heavy traffic and adverse weather conditions contribute to the involvement of approaching vehicles in accidents so as to aggravate the seriousness of any incident.

Studies indicate that there are three inter-dependent considerations: the first is the rapid transmission of alarms to proper authorities and a simultaneous warning to approaching vehicle operators; the second is the response of appropriate apparatus and manpower with a minimum of delay; the third is a matter of rescue operations, followed by fire extinguishment when necessary.

When lives are endangered by fire, the possibility of effective rescue operations decreases rapidly with any delay. The reporting of accidents by drivers of passing vehicles loses much of its value unless adequate and readily available means of communication are provided. Distances to interchanges, service areas, and toll booths, or other communication facilities, and indecision, due to unfamiliarity with the facility, will often consume the limited time available for effective action.

Control of traffic is a continuous problem from the time of the occurrence of any emergency to the time of removal of the occupants and vehicles from the highway. Police patrols have, on occasion, been overwhelmed by the volume and speed of traffic. Experience has indicated that the slowing of traffic is, nonetheless, essential to the minimizing of the hazard of multiple collisions once an accident has occurred.

Role of Highway Patrols

Primary dependence for the reporting of incidents is, in many instances, placed upon radio-equipped highway patrol cars. Many highways are protected by extremely efficient highway patrols, some arranged to keep all portions of the facility under surveillance at intervals of not more than ten minutes. However, such schedules are subject to disruption and delay by minor incidents and the apprehending of law violators,

California Division of Highways

Compare this view of the start of the Santa Ana Freeway with the view at right taken from the same location five years later.

California Division of Highways

The same view as at left five years later. Preplanning is necessary to reach accident sites on limited access thoroughfares.

which seriously disrupt the frequency of patrols past any given point on the longer highways. Studies have revealed that patrols may be delayed for periods of thirty minutes to more than one hour, depending on traffic conditions and incidents requiring the attention of the patrol officers.

Added Problems With Tunnels, Bridges

Certain of the structures which are accessory to our superhighways present special problems in fire protection which are not common to the open highway. When accidents with resulting fires, or serious fire potential, occur in tunnels, the problems encountered on the highway are multiplied by reason of sloping road beds, ventilating systems which may be inadequate to cope with combustion gases and heat, and possible interruption of illumination facilities. In unsprinklered tunnels, this problem is particularly severe. Elevated structures and bridges present problems similar to those encountered on the open highway, but they are compounded by reason of lack of accessibility and the potential destruction of the structure by exposure of critical supporting members to heat and flame attack.

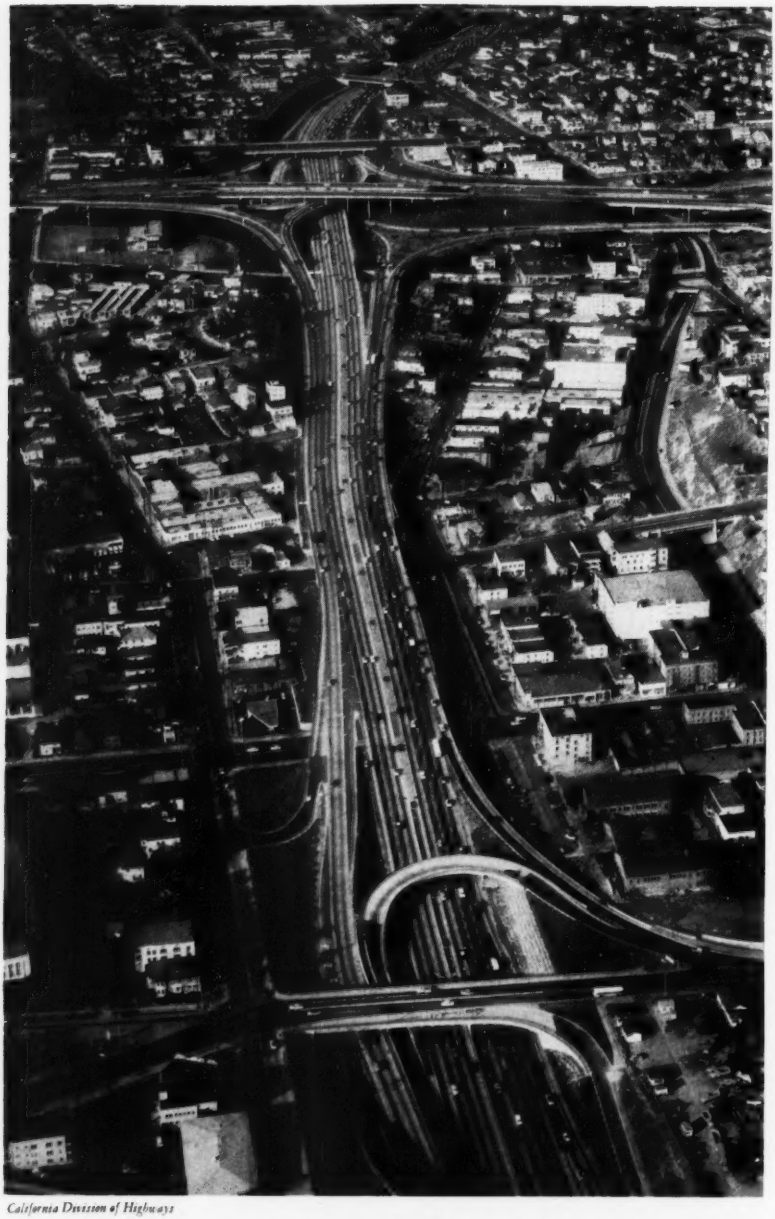
Responsibility Question

Whether or not the responsibility for maintaining a reasonable degree of fire protection on these facilities is a responsibility of the operating authority, is a matter which has not been well established. However, where tolls are charged, it appears that the operating agency has certain legal responsibilities, and in those cases where tolls are not charged, at least there is a moral responsibility on the part of the operating authority, which must not be overlooked. In all instances the operating authorities must be well versed in matters of fire protection, and prepared to effectuate a complete program of fire protection.

It is evident that there has been some general recognition of the fire protection problem on certain of our modern highways. In some instances, contracts have been negotiated between the operating authority and the various fire departments enroute, whereby municipal fire companies and emergency squads respond on receipt of alarms within distances up to fifteen miles. In certain cases, however, local municipal protection is not available, particularly on limited access highways where the lack of access lanes nullifies the feasibility of such services. It is generally considered that under these conditions municipal protection can only be considered supplementary to that which should be provided by the operating agency.

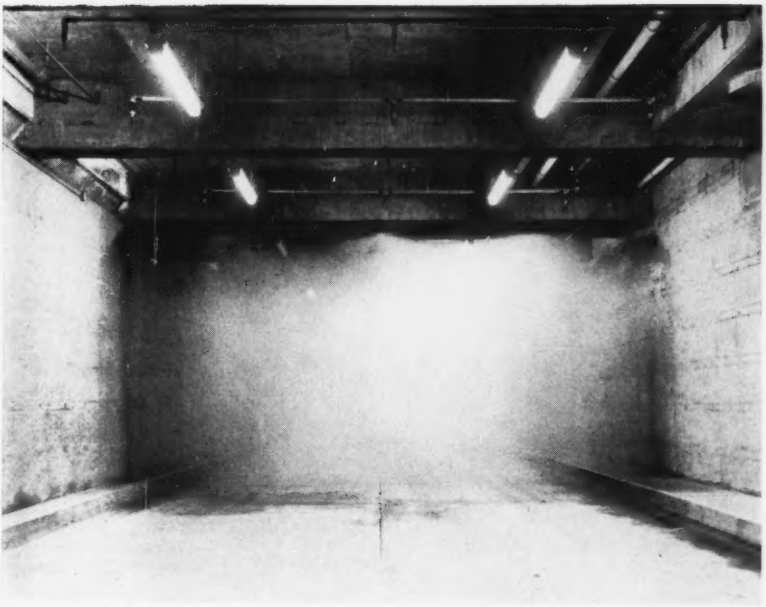
Restricted Use Philosophy

In certain instances, operating authorities have attempted to minimize the fire hazard potential by restricting the use of the facilities to private passenger vehicles. Obviously, such limitation precludes the maximum economic use of the highway, and in some instances, such limitations have resulted in extremely unprofitable operation of toll facilities. Furthermore, such restriction defeats the purpose of the highway to a great extent in that it thereby does not relieve adequately traffic congestion on city streets. In other instances, structures requiring fire protection (such as restaurants and service stations) have been excluded from these facilities. This policy does not seem to be consistent with the needs of the traveling public, and such a policy results in further congestion at interchanges and adjacent communities since service facilities, including restaurants and service stations, would then be concentrated near the highway exits. It seems certain, therefore, that most modern highway facilities will be used by all types of vehicles and cargoes presently permitted on public thoroughfares and that structures requiring fire protection will be essential to efficient operations. The only exceptions may be that certain facilities (such as tunnels) may exclude certain types of cargo vehicles hauling "dangerous" commodities. It follows



California Division of Highways

Los Angeles is famous for its "freeways." This view looks north along the Harbor Freeway showing the 3rd Street connecting ramps in the foreground. Traffic control along such superhighways is an essential to handle emergencies effectively.



City of Seattle, Engineering Dept.

Sprinklers for vehicular tunnels are recommended. In the 2,134-ft.-long Battery Street Subway in Seattle automatic open-head deluge type sprinklers are installed. Fourteen separate six-inch systems are under automatic rate-of-rise and fixed temperature control. The systems also can be manually operated from inside the tunnel. Each sprinkler provides coverage for 72 square feet of roadway and sprinkler deflectors are positioned two inches above the bottom of the 34-inch-deep concrete beams.

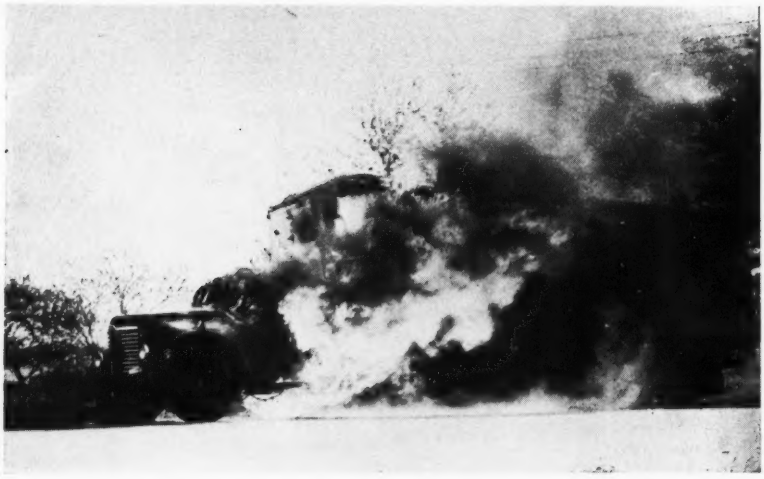
that essential features of fire protection must be provided in the public interest.

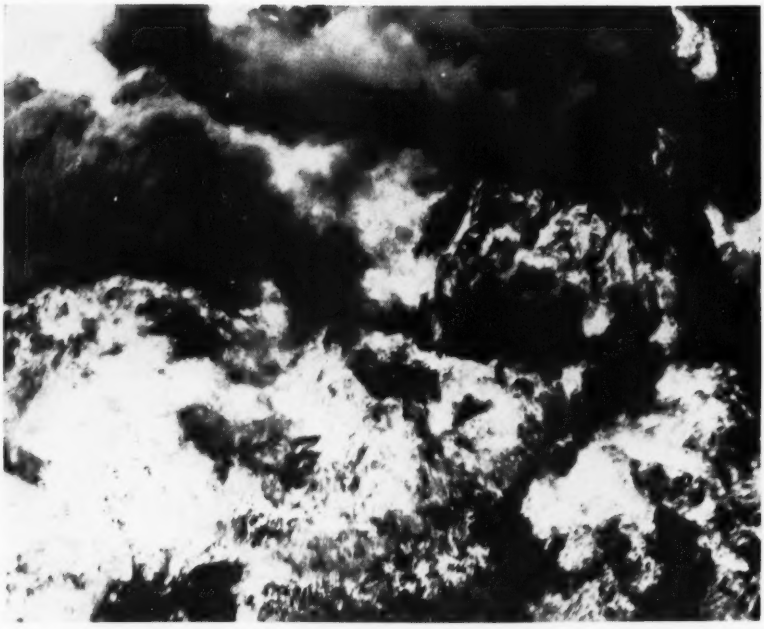
Highway Recommendations

The following comments and recommendations are deemed to be worthy of consideration by those responsible for the construction and operation of limited access highways and accessory structures. Most of these recommendations are included in a publication issued by the National Board of Fire Underwriters titled "Standard for the Protection of Limited Access Highways, Tunnels and Bridges" (NBFU No. 502) which is available from their offices.

Safety Aisle Utilization

Highway construction of the safety aisle, or separated roadway design, should include the installation of direct buried underground cable, installed in the center strip, to provide circuits for emergency alarm use and for traffic control systems, warning signs, lights and voice transmission. The center strip location may be criticised because of the need for lateral crossings of the roadway to extend circuits to emergency reporting stations on the right hand shoulder so as to be accessible from the slow lane of traffic. Where lateral crossings are impractical it will be necessary to install dual cables along the outer edges of the roadway. I recommend, however, that further study be given to the location of all service facilities, maintenance buildings and communication facilities in the center strip with the approach and departure lanes from the fast traffic lane.





Associated Press Photo

Overfilling of the gasoline tanks on this tractor-trailer truck and subsequent spillage caused a fire when the fuel dripped on the exhaust piping. The top photo shows the extent of the fire before the fuel tanks exploded which produced the flash fire seen in the lower photo. The accident occurred on U. S. Highway No. 20 on May 4, 1955 near Fredonia, N. Y.

Communication Centers

It is further suggested that consideration be given to combining service areas, maintenance depots and communication headquarters at single locations at about 30-mile intervals on open throughways rather than random spacing of individual installations and structures. Such concentrations of structures, with reasonable exposure separation, would minimize the fire protection problem by reducing the number of protection installations required. The foregoing comments are closely related to the following specific recommendations intended to provide an acceptable degree of fire protection.

Public Alarm Stations

Primary consideration should be given to the installation of an emergency alarm system whereby notification of emergencies may be transmitted to an appropriate authority by the general public from locations along the highways at not more than two-mile intervals. When located in the center strip, only single stations are required, but where outside locations are necessary, the stations should be installed opposite each other so as to discourage crossing of the traffic lanes by pedestrians. Alarm transmission may be provided by the installation of outdoor telephone type boxes, or coded fire alarm telegraph stations. They should be made conspicuous by indicating lights and markers. All patrol vehicles, maintenance trucks, service cars, and emergency apparatus as well as toll booths, should be equipped with three-way radio systems.

Highway Fire Stations

Where suitable municipal apparatus, with adequate manning, is not available within a road-traveled distance of five miles, or where response within a period of ten minutes cannot be assured, fire stations with properly designed and equipped apparatus should be located at approximately thirty-mile intervals on any open highway. Such apparatus should be manned by trained personnel and should be located at maintenance and service areas where at least one man is on duty at all times and where additional personnel is available on short notice.

Highway Fire Apparatus

Apparatus should generally be of the conventional type with some modification. Where appropriate, combination apparatus providing the essential features of fire apparatus (as described below), together with that equipment normally provided on automobile wrecker or crash type emergency equipment, should be used. Apparatus should carry essential first aid equipment and could be designed so as to permit the transport of injured persons where rescue or ambulance equipment is not provided as a separate service.

At minimum, apparatus should be built on a chassis of adequate load rating; be radio-equipped; have a large capacity alternator with a three-phase transformer, a 200-gallon-per-minute pump operated through a power take-off; a water tank of at least a 300 gallon capacity; an inline dual proportioner with a 30-gallon foam solution tank, and a 30-gallon wetting agent tank, or equivalent equipment; two 200-foot preconnected lines of 1½-inch cotton rubber lined hose; one turret mounted on the cab roof, two 15 to 25 lb. dry chemical extinguishers; two loaded stream extinguishers; assorted entry tools; and a collapsible ten-foot ladder, shovel, flood lights, cutting torches and power tools. When such apparatus is to serve as wrecking equipment, a power winch for use in conjunction with a demountable "A" frame and heavy jack should be provided. In remote areas, where water supplies are available from natural sources, portable pumps should be carried on maintenance vehicles.

Mutual Aid Arrangements

In addition to such specialized highway apparatus, definite arrangements

for the response of nearby municipal fire companies and emergency squads should be made. Access roads permitting the entrance of outside fire companies to the facility should be provided where feasible.

Protection of Servicing Areas

Service and maintenance areas and permanent installations should be protected by automatic sprinkler systems and public water supply systems, with accessible hydrants, where such supplies are available. Where public water supplies are not available, sprinkler systems should be supplied from pressure tanks and wells. Storage of at least 50,000 gallons as suction supply to fire department pumpers should be provided for unsprinklered buildings.

Emergency Traffic Control

Emergency traffic control systems designed to interrupt or retard traffic should be installed. Such equipment would serve the dual purpose of preventing the involvement of additional vehicles in one accident and of slowing traffic during inclement weather conditions. It is suggested that such equipment be installed on a zone control basis, with provision for control by an operator at a central location or at toll booths.

Training of Personnel

In order to derive maximum benefit from the recommended features, comprehensive training programs are necessary for all personnel expected to participate in fire fighting and emergency operations. Such a program should involve the employment of a competent supervisory staff, experienced in fire fighting techniques.

Public Education

In addition to the training of highway personnel, steps should be taken to inform the general public as to the facilities provided for their protection, and definite instructions should be issued concerning the procedure for calling for assistance and reporting

Acme

This truck caught fire in the Holland Tunnel and had to be towed out after Port Authority personnel controlled the blaze in the tunnel. Foam and carbon dioxide were used in extinguishing operations with tunnel fire mains supplying water for foam by pick-up nozzles.

Acme

The most serious tunnel fire occurred on May 13, 1949 when a 16-ton trailer truck loaded with eighty 55-gallon drums of carbon disulphide caught fire in the Holland Tunnel between New York and New Jersey. Ten trucks were destroyed and a 500-foot section of the unsprinklered tunnel was heavily damaged (see July 1949 NFPA Quarterly, page 78). The fire demonstrated the efficiency of the communications and ventilation system in the tunnel and the need or more rigid inspection of truck cargoes accepted for tunnel traffic (see October 1951 NFPA Quarterly, page 144).

emergency situations. It is suggested that the reverse side of tickets issued at toll booths bear suitable instructions with prominent and appropriate notation on the face; where no tickets are issued for the use of the facilities, signs should be provided or folders distributed at toll booths, service areas and information centers.

Tunnel Recommendations

The following recommendations are applicable to tunnels.

Tunnel Alarms

Means should be provided whereby emergency alarms may be transmitted either by the general public, or by patrolmen stationed in the tunnel. This may be by the installation of coded alarm or outdoor type telephone boxes at intervals of not more than 300 feet, or at posts of foot patrolmen, where they should be made conspicuous by indicating lights and markers.

Tunnel Traffic Control

A traffic control system should be provided, interlocked with the fire alarm system turning all signals red between the point of alarm transmission and the tunnel entrance, and yellow between that point and the tunnel exit, or controlled by personnel on duty with definite instructions for emergency procedures. When supervisory or toll collection personnel are on duty, it is suggested that consideration be given to the installation of a limited range radio

transmitter, broadcasting over an unused commercial station frequency, by means of bare wire on insulators near the top of the tunnel. Such transmission could then be received on automobile radios, by occupants notified of this service, by signs, and by public address systems used for announcing traffic and emergency conditions.

Tunnel Fire Apparatus

Suitable apparatus should be available within one mile of each tunnel exit, but preferably at the exit location. Apparatus should be similar to that recommended for limited access highways, but due to the limited operating conditions, it should be designed for double-end operation; equipped with "dollies" for towing disabled vehicles from the tunnel; carry an adequate supply of water, foam, complete self-contained breathing apparatus, cutting torches, forcible entry tools, and tarpaulins for protecting exposed vehicles. These vehicles should be radio-equipped.

Tunnel Sprinklers and Water Supplies

A water supply system adequate to supply sprinklers and 1500 g.p.m. for standpipe hose streams should be installed, connected at each end to storage tanks, or supplied from an adequate municipal water system when available. Mains of at least 6-inch diameter should be placed on each side of the roadway with suitable interconnection and valving facilities to allow isolation and repair of any section without materially impairing the supply. Hose connections should be installed and conspicuously marked at a maximum of 150-foot intervals. Where freezing conditions are likely to be encountered, piping should be protected and a small pump should be provided to continually circulate water through the system. Serious consideration should be given to the installation of zone controlled manual deluge sprinkler systems in long tunnels since fires in such structures have resulted in extensive structural damage and difficult fire fighting procedures.

Wide World

Bridge fire fighting truck attacking flames involving 2 cars on the San Francisco-Oakland bridge following a 4-car rear-end collision.

Tunnel Portable Extinguishers

Fire extinguishers suitable for hand use on all classes of fires should be placed on both sides of the road bed in well-marked flush wall cabinets at intervals of not more than 200 feet. Sand boxes of ten-cubic-foot capacity should be placed at every 500 feet.

Tunnel Ventilation

The ventilation system should be designed to completely change the atmosphere within the tunnel about every two minutes and to keep the concentration of carbon monoxide below four parts per ten thousand under heaviest conditions. For emergency ventilation and standby units, at least 25 per cent overcapacity should be installed. It is strongly recommended that, when supervisory personnel are continuously on duty, the system be designed on a sectional basis so that when an emergency occurs the blower fans in the section involved and the exhaust fans of adjacent sections can be shut off, thereby creating a longitudinal flow of air directed toward the fire area.

Tunnel Drainage

An adequate drainage system should be provided with a sump pump at every low point in the tunnel.

Bridges and Elevated Highways

Bridges and elevated structures merit special consideration because of the lack of accessibility.

Bridge Alarms

It is essential that means be provided for the transmission of emergency alarms. This may be accomplished by the installation of outdoor type telephone or code alarm boxes at intervals of approximately 500 feet on bridges and 800 feet on elevated highways. They should be conspicuously marked and provided with indicating lights.

Bridge Traffic Control

A traffic control system should be provided so that vehicles will stop or proceed with caution. On elevated highways it is desirable that such a system be designed on a block basis and interlocked with the alarm system so that traffic in adjacent blocks will be notified. On bridges, it is desirable that the interlocking with the alarm system be such that all signals between the point of alarm transmission and the bridge approaches be turned red.

Bridge Fire Apparatus

Suitable apparatus should be available within one mile of all points on

Redwood Empire Association

One of the most beautiful structures of its kind in the world, the Golden Gate Bridge links San Francisco with the rest of the Redwood Empire. Note in the far background the southern entrances of the Golden Gate Bridge Freeway twin tunnels.

elevated structures and bridges; municipal apparatus may afford adequate protection where structures are accessible from ramps and ladders. Design of apparatus intended for use on bridges or elevated structures should be similar to that recommended for open highways, and should have braking equipment adequate under all conditions, both to maintain a position on any existing slope and to restrain disabled vehicles being towed from such slope. The apparatus should be radio-equipped.

Bridge Water Supplies

Standpipe systems capable of supplying not less than 500 gallons per minute at suitable pressure should be installed, to be supplied from pumpers in the street below and, if available, from fire boats or drafting points. It is desirable that duplicate systems be installed in each side of the roadway and that the systems be cross-connected. Where freezing conditions prevail, systems should be of a dry type. Such systems have been recommended for certain installations but in most instances installations have been limited to railroad bridges where actual need has been demonstrated.

Bridge Sand Boxes

Boxes or piles of sand should be provided for use during icy weather conditions and for diverting or restricting the flow of flammable liquids.

Conclusions

These comments have been prepared for the guidance of those individuals and agencies responsible for the construction, operation and maintenance of modern, limited access highways and structures. Such facilities, by reason of their design, present fire protection problems not normally encountered on conventional traffic arteries.

The recommendations set forth are applicable to existing facilities and special consideration should be given to these matters in the planning of future construction. Compliance with the recommendations will reduce the inherent hazards of fire as affecting safety-to-life, the destruction of highway vehicles, damage to buildings, structures and equipment functional to the operation of these facilities, and the protection of motor vehicle cargoes of ever increasing values. They also apply to a lesser extent to buildings and structures so located as to be exposed to the hazards of highway operations.

Of course these suggestions and recommendations do not completely resolve the problem, neither do all of the features apply to all construction. However, the recommendations are worthy of consideration and certain suggested innovations with regard to location of structures and tunnel sprinkler protection merit further study and constructive thinking.

Uranium Scrap Fire Control

By F. L. Brannigan*

Safety Engineer, Safety and Fire Protection Branch

United States Atomic Energy Commission

Normal (or depleted) uranium† scrap is generated in the machining of massive uranium metal to produce reactor fuel elements in a variety of shapes. It is quite subject to spontaneous ignition, though fire can generally be avoided by storage completely submerged in oil or water. Extremely fine material such as grinder dust has been known to ignite even under water. Fires also occur in coarser scrap as a result of failure to immerse the material completely or because of damage to drums which causes the water to leak off.

In outside storage, such fires can be handled by well-proved techniques. The drums near the burning drum are removed by an operator on a shielded forklift truck. The burning drum is placed in a larger drum which is then filled with water. Hydrogen gas is generated but burns off or is dissipated in the open. (The problem of the generation of hydrogen gas in storage is not considered in this article.)

As progress is made in the peacetime uses of atomic energy, more and more normal uranium will be handled in private industrial plants and research activities. Many such locations, particularly in cities, lack convenient outside storage facilities. The question arises as to the safest way to protect the storage of normal uranium scrap within a building.

It was believed that automatic sprinkler coverage would be satisfactory for the protection of normal uranium scrap in inside storage, but there was little data to counter the opinion that operation of automatic sprinklers on a normal uranium fire might result in a serious hydrogen explosion. Accordingly, tests were conducted by the Health and Safety Division of the AEC Feed Material Production Center, Fernald, Ohio, operated by the National Lead Company of Ohio.

The Test Fires

The test fires involved 30-gallon drums of normal uranium scrap (about 250 pounds per drum). All drums but one contained scrap under water soluble coolant. The dry drum was fired. The numbers shown in Figure 1 show the location of the fire drum for each test.

Conclusion

The conclusion is drawn that automatic sprinkler protection is satisfactory for the storage of normal uranium scrap. While the fire in the drum of origin may not be extinguished, it is most unlikely that the fire will extend beyond the drum of origin. No violent hydrogen explosion results even when a sprinkler discharges directly into a drum of burning uranium.

The following recommendations are made:

1. Automatic sprinkler systems should be supervised.

2. Lowest practicable temperature rating on heads.

---

* Member, Chesapeake Chapter, Society of Fire Protection Engineers.

† Normal, i.e., natural uranium. For the protection of uranium enriched in the *fissionable* isotope U-235, water is *not* indicated due to its moderating and reflecting qualities which might create accidental critical masses. Depleted uranium is uranium in which the proportion of U-235 has been reduced.

3. "Hazardous occupancy" spacing and pipe schedule should be employed.

4. Heads should be of the current standard type (formerly known as spray sprinklers).

5. Storage should be "honeycombed" to permit waterflow around all can surfaces. Avoid direct contact between cans.

At the time these tests were conducted the outdoor temperatures prevailing were between 31° and 34° F. In order to determine whether the results would be the same if the scrap had been stored at summer ambient temperatures, the tests will be repeated during the summer.

Test Description, General

The tests were all conducted in a covered shed (see Figure 2) on January 29 and 30, 1957. Temperatures were 31–34° F. and on the 29th some snow was falling; on the 30th, the day was dry. Winds were light.

Figure 1. Test setup conducted with drums of normal uranium under sprinkler protection. Numbers indicate location of the fire drum in each of the four tests.

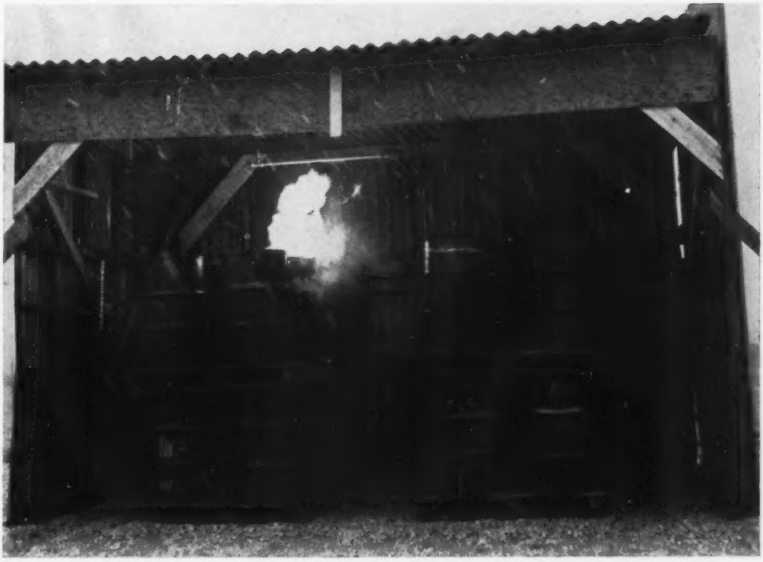


Figure 2. Test No. 1 shortly after ignition. The cover of the fire drum had just blown off from internal pressure. Sprinklers had not yet released. (Streaks in the photo are falling snow.)

Figure 3. Test No. 1 after sprinklers started to operate. Note smoke and steam with extreme heat near bottom of drum.

Figure 4. Test No. 1 after fire was virtually extinguished. No flame is visible and fire drum has been cooled by effective sprinkler action.

Test No. 1

Figure No. 1 shows the test setup and the fire drum is indicated by the figure 1 in that diagram. Figures No. 2, 3 and 4 are photographs of this test in various stages. The sprinklers used were standard sprinklers with 165° ratings. Thermocouples were placed in the center of the structure at the roof beam, between fire drums and other exposed drums on two sides. The highest reading secured during the fire test on any of the thermocouples was 150° F.

The following time record and comments apply to this test:

0:00 Drums of chips ignited manually.

0:03 Flames emitting from under drum lid and through vent holes in the drum.

0:05 One sprinkler head released over the fire.

0:08 The drum lid blew off due to internal pressures.

0:18 Sprinkler head knocked down the fire and no visible flames were still apparent. The drum was still "red hot."

0:20 The sprinklers were shut off (the right hand sprinkler never did actuate). No visible flames were above the drum and the contents of the fire drum had been reduced in volume, having been converted to black oxide, and about three inches of water was in the bottom of the drum.

0:23 The fire drum was removed from the structure, placed in an empty, dry 55-gallon drum and flooded with water. Flame from gas burning off above the water subsided in three to five minutes. There was no charring or scorching of the wooden structural members in the test building or of the pallets.

Test No. 2

The test setup was the same as in the previous test and as indicated in Figure No. 1. This time the fire drum was placed in the inside corner of the rear bottom pallet as shown by the figure 2 in

the diagram. Standard upright sprinklers were used, the left sprinkler having a 175° rating and being of the solder type. The right sprinkler was also an upright with a rating of 135° and was of the bulb type. Thermocouples were placed as in the previous test. The highest rating in this test of any of the thermocouples was 1000° F.

The following time record and comments apply to this test:

0:00 The drum of lathe turnings and sludge was ignited (three unsuccessful attempts were made to ignite the turnings so that two small holes were made in the drum near the bottom to admit air. Following this action it was possible to ignite the turnings).

0:02 Flames emitted from under the drum lid and from the top vent hole of the drum with considerable intensity. The bulk of the flame was toward the center aisle space.

0:04 The sprinkler on the left side (not over the burning drum) released. Flames continued intensely from under the drum lid in all directions and from all holes.

0:06 Mild, muffled explosions occurred from within the drum. Burning uranium particles were spewed six to eight feet from the drum. Intense flame was noticed from all holes in the drum and the maximum reading of 1000° F. probably occurred at this time.

0:09 Anticipating possible collapse of the upper wooden pallets, a 1½-inch hose line was placed in service and water was directed on the pallet and drums to subdue the fire.

0:10 A second 1½-inch hose line was placed in service and operated on the fire.

0:11 The second sprinkler head on the right side over the fire area released. It is believed that it was struck by a hose stream. Considerable smoke and steam obscured clear observation of the fire area.

0:14 Two front pallets from the right side were removed to reach the burning drum. At

Figure 5. During Test No. 2 an intense fire developed which threatened to ignite wood pallet under fire drum. After test was over, the pallet was found charred but structurally strong.

Figure 6. Burning in fire drum just before sprinklers released in Test No. 3.

this time the thermocouple reading dropped to around 200° F.

0:15 Sprinklers were shut off.

0:19 The lid was removed from the fire drum. No flames were visible above the drum lip but flames were still coming from the lowest vent hole.

0:22 The burning drum was removed from the structure, placed in a dry 55-gallon drum and flooded with water. Gas flames burned above the water for several minutes. It was observed that the wooden pallet under the fire drum was badly charred but structurally strong. The exposed corners and edges of other wooden pallets were scorched and slightly charred.

Test No. 3

This test was conducted under the same conditions as in the previous tests except that a metal pallet was substituted for a wooden one directly above the fire drum. The fire drum was on the inner corner of the front lower pallet on the right side as shown in Figure No. 1 by the figure 3. The sprinklers used were standard upright solder type devices with 165° ratings. Thermocouples were attached to the roof beam, inserted in the fire drum and in the bottom of the metal pallet above the fire. The readings on these thermocouples during this test were not conclusive but it is possible that a reading of 1000° F. occurred during this test as in Test No. 2. A small quantity of fine magnesium chips were used to kindle the fire in the uranium scrap.

The following time record and comments apply to this test:

0:00 Fire ignited (magnesium flared violently).

0:01 Fire burning vigorously in top of drum.

0:015 The sprinkler over the fire area released. A moment later there was a muffled mild explosion within the drum which may have been caused by the sprinkler discharge into the vent hole or water entering under the drum lid contacting magnesium.

0:02 The middle of the fire drum was observed to be "red hot."

0:04 Intense flame was emitting from under the drum lid and from the vents. The fire spread from beneath the metal pallet resting on the top of the fire drum. By this time the bottom of the fire drum was observed to be "red hot."

0:10 The sprinkler water supply was shut off. The left sprinkler head had not operated. The contents of the fire drum were still burning.

0:13 The fire drum was removed and the flames had reduced considerably. The drum was then placed in a dry 55-gallon drum and flooded with water. The gas burned over the water for about three minutes. There was no extension of fire in the test structure to other drums or pallets.

Test No. 4

In this test the same test facility was used and the fire drum contained uranium lathe chips and uranium sludge and was in the same position as in Test No. 3 as shown in Figure No. 1. Again, standard sprinklers of the solder type with 165° ratings were used. The thermocouples were placed on the roof beam and around the fire drum. The highest temperature recorded was 130° F. but this reading was considered inconclusive and the equipment was probably not operating properly. The following time record and comments apply to this test:

0:00 The fire drum contents were ignited with the aid of magnesium.

0:02 The drum contents were burning vigorously.

0:04 Flames were emitting from under the drum lid and spread out under the entire pallet placed on the top of the fire drum.

0:05 Burning uranium particles were emitting from vent holes.

0:07 The sprinkler over the fire released.

0:08 The fire was still burning intensely.

0:095 The left sprinkler head released. The fire was still intense.

0:13 The whole fire drum was "red hot" but the flame intensity decreased.

0:14 Small flames were emitting around the top of the drum.

0:17 No visible flame remained.

0:20 Sprinklers were shut off.

0:24 The fire drum was opened. No flame emitted from the top of the drum. The drum was then placed in a dry 55-gallon drum and flooded with water. The area of the pallet under the fire drum was badly charred but structurally strong. The corners and edges of exposed wooden pallets were badly scorched. The metal pallet above the fire was blackened in spots but not distorted or noticeably damaged.

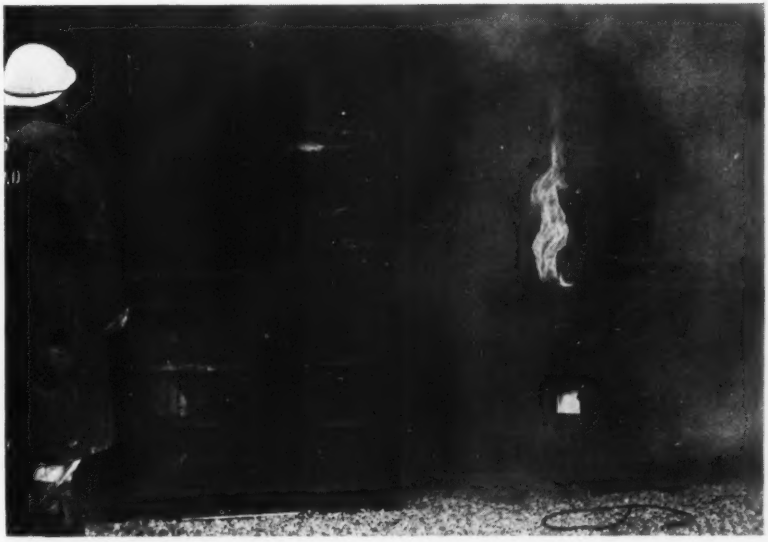


Figure 7. Fire in Test No. 3 being brought under control by sprinklers.

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STOCKED BY PRINCIPAL JOBBERS IN MAJOR CITIES. FACTORY WAREHOUSES IN AKRON, ATLANTA, DALLAS, NEWARK, DES MOINES, CHICAGO, NEW ORLEANS, LOS ANGELES

Before you fill in the coupon below read how this

FREE Rockwood Booklet Can Help You

Contains Valuable Special Hazard List!

The new Rockwood booklet asks the question "Do You Have a Hidden Enemy in Your Plant?" and helps you answer it with a Special Hazard List. With this list you can determine if you have a potential fire lurking in your plant.

Many Case History Pictures!

The new Rockwood booklet has many case history pictures showing how Rockwood FogFOAM, FOAM and WaterFOG systems have been engineered to control or put out costly and difficult fires in electric equipment, in gasoline and other similar hazardous products, in addition to extinguishing fires in ordinary combustibles.

Helpful Information On Rockwood Products!

Rockwood fire-fighting products for special hazards and fixed piping installations are pictured, and the technical facts are stated. No sales talk — just information.

Send For This Informative FREE Booklet

Fill in the coupon below and we'll rush the Special Fire Hazard booklet to you by return mail.

ROCKWOOD SPRINKLER COMPANY

Engineers Water . . . to Cut Fire Losses

ROCKWOOD

ROCKWOOD SPRINKLER COMPANY
2462 Harlow Street, Worcester 5, Mass.
Please send me your illustrated booklet on Special Fire Hazards.

Name.....

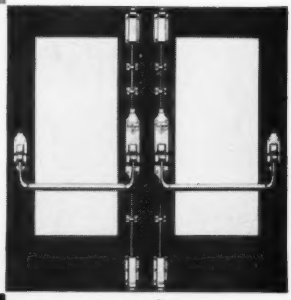
Title.....*Company*.....

Street.....

City.....*Zone*.....*State*.....

Get your exits

ready for increased traffic



Call in your

Von Duprin
"EXIT SPECIALIST"

● Increased production for your plant means more employes, more traffic, more need than ever for safe, dependable exits. Call in your Von Duprin "Exit Specialist" for a free survey of your exit requirements. From actual experience, he can recommend the right Von Duprin exit devices to give you the greatest safety and service. Von Duprin is the most complete line of approved exit devices. From this one line, you can meet *all* your present and potential exit hardware needs. If you don't know the name of your nearest "Exit Specialist," write Von Duprin.

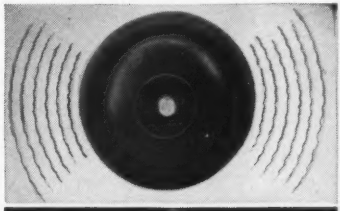
FREE Reserve a showing of Von Duprin's 20-minute sound movie, "Safe Exit." Build a lively safety program around this interesting public service film. Write for a booking.

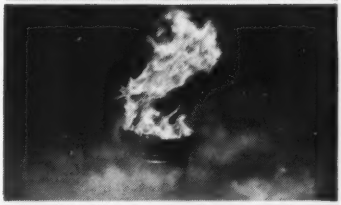
VONNEGUT HARDWARE CO. • VON DUPRIN DIVISION • INDIANAPOLIS

Von Duprin Fire and Panic **EXIT DEVICES**

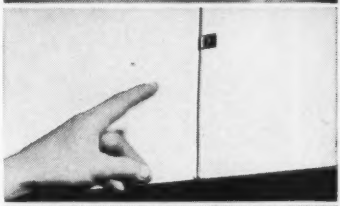
THE SAFE WAY OUT!

FIRE ALARM!



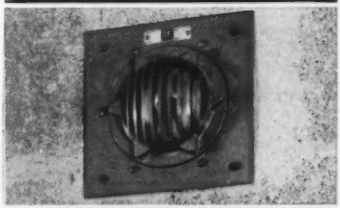


AT THE FIRST HOT BREATH OF FIRE



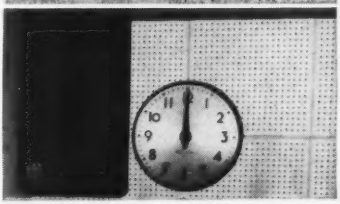
KIDDE'S ATMO ALARM SYSTEM

(using rate-of-temperature-rise tubing)



TRIGGERS ALARM AT FIRE AREA

(outside building or at local fire department)



GIVES FIRE LOCATION AT ANNUNCIATOR PANEL

(usually at manned telephone switchboard)

Save priceless lives, save valuable buildings with Kidde's Atmo Fire Alarm System. This wide-area automatic fire detecting and warning system sounds alarm almost the moment fire starts. Ideal where life protection and early fire warning is essential, the Kidde-Atmo system operates independently of regular power sources, gives protection even if outside power fails. What's more, the system can close doors, shut off fans, motors, blowers. Is automatically self-resetting after use or test. Write today for Kidde's Atmo Alarm System booklet.

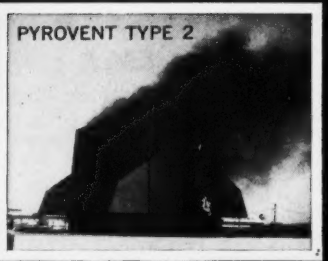
Kidde—Atmo
FIRE DETECTION

J. H. SCHARFF, INC.
751 Main Street, Orange, N. J.

A Subsidiary of
Walter Kidde & Company, Inc.

For COMPLETE Protection...

Include WASCOLITE PYRODOMES! Smoke, flames, explosive gases are vented automatically for complete protection. WASCOLITE PYRODOMES and PYROVENTS make sprinklers doubly effective in reducing dangerous temperature build-ups on roof decks. Your fire protection is assured with WASCOLITE PYRODOMES and PYROVENTS!



For information write:

WASCO PRODUCTS, INC.

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FREE!

Specialized Help on Fire Alarm System Specifications

Send me the free Flexalarm Fire Alarm System Planning Guide, F249.

Name..... *Title*.....

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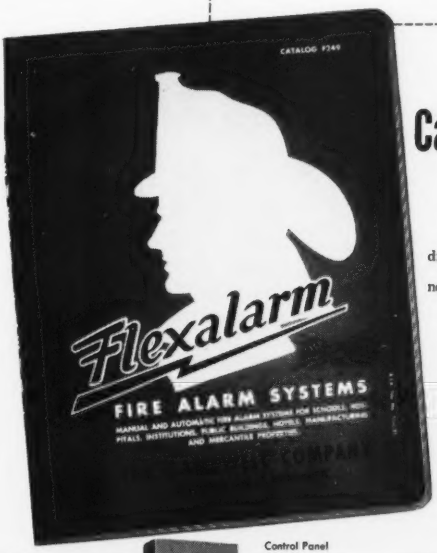
Address.....

City..... *Zone*..... *State*.....

Send Coupon or write for Flexalarm F249 TODAY! And, we'll keep you informed on new developments and systems.

Mail to: The Gamewell Co., Dept. BB
Newton Upper Falls 64, Massachusetts

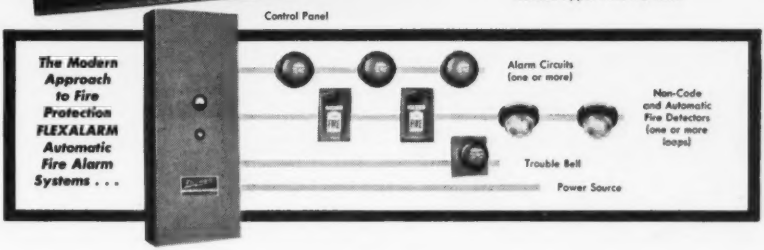


New Catalog for Architects and Engineers

Here's an advanced, easy-to-use technical digest on the design, application and specification of interior fire alarm systems. It features a new building-block concept based on Gamewell experience in signaling and communications. F249 includes suggested systems and layouts, gives you a complete one-source reference for planning the best possible protection against the hazards of fire.

GAMEWELL®

THE GAMEWELL COMPANY
Newton Upper Falls 64, Mass.


Control Panel
The Modern Approach to Fire Protection FLEXALARM Automatic Fire Alarm Systems . . .
Alarm Circuits (one or more)
Non-Code and Automatic Fire Detectors (one or more loops)
Trouble Bell
Power Source

LOW COST
FIRE & EXPLOSION PROTECTION

for FLAMMABLE LIQUID STORAGE

Flame Arrester Unit listed by UNDERWRITERS' LABORATORIES Approved by Associated Factory Mutuals Laboratories and other governing agencies.

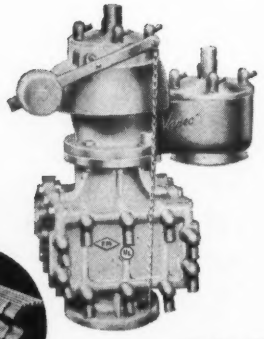


Fig. No. 5800A Conservation Vent Unit consisting of VAREC Vent VALVE in combination with VAREC FLAME ARRESTER

You can rely on VAREC CONSERVATION VENT UNITS to provide full fire protection on your liquid storage at low cost. Protection against entry of flame through the venting device is certain when Varec Flame Arresters are used. Protection against excessive pressure or vacuum is assured by the VAREC VENT VALVE. The combination unit gives you complete security against major hazards of flammable liquid storage. Average installation costs 1/10th of 1% of your investment in tank and products. Secure full details from your VAREC Representative or write factory.

NF-3

"Varec"

THE VAPOR RECOVERY SYSTEMS COMPANY

COMPTON, CALIFORNIA, U. S. A.

Cable Address: VAREC COMPTON USA (All Codes)

Recall the old saying "An ounce of prevention is worth a pound of cure". Lexsuco Fire-Retardant Roof Constructions can be the "ounce of prevention" for your building. A Lexsuco Roof eliminates flammable asphaltic materials from between the roof deck and insulation. It will not feed a fire, will not spread a fire and eliminates dense, black smoke, making fire-fighting possible. Make the building you build or insure fire-retardant with Lexsuco Roof Constructions.

. . . fire-retardant roof constructions

APPROVED BY FACTORY MUTUAL AND FACTORY INSURANCE ASSOCIATION

LEXSUCO, INC.
Department FA-77
4815 Lexington Ave.
CLEVELAND 3, OHIO

WRITE FOR INFORMATIVE BROCHURE

Name & Title_____
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LEXSUCO
INCORPORATED
4815 LEXINGTON AVENUE
CLEVELAND 3, OHIO
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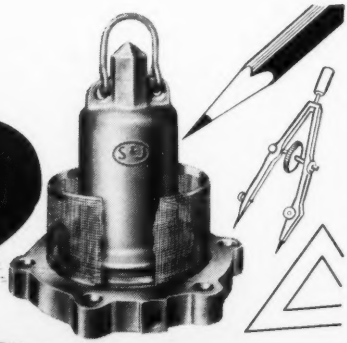
maximum Safety minimum maintenance!



S & J Hydraulic Internal Safety Valves were designed with Safety principally in mind. To pass or stop the flow of liquid was secondary. From stem to stern they reflect Safety all the way. They are not mere adaptations or revisions of gate or globe valves. They were conceived and designed as Safety Valves.

They are not only cheaper and faster to install—particularly when your truck tanks have more than 4 compartments —but hydraulic pressure is applied through lines of copper tubing—a fully enclosed system—not bedeviled by dust, mud, snow, sleet, corrosion, lack of lubrication, loss of cotter keys and all of the other things that interfere with the proper operation of the actuating mechanism of mechanical valves.

If you want Safety Valves that give you the maximum in Safety—Specify S & J Hydraulic Internal Safety Valves.

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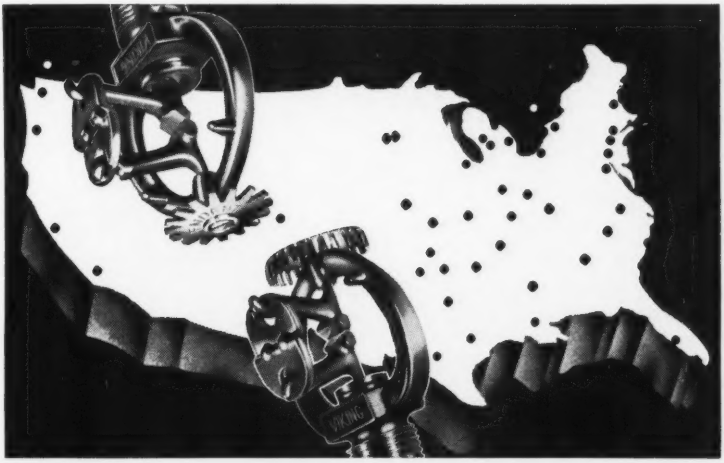
MEXICO, D.F.: Dalmo Comercial, S. A.
CARACAS: Sinclair Spence, C.A., Edificio Gulipan
ENGLAND: Whessoe, Ltd., Sales: 25 Victoria St., London S. W. 1
Whessoe, Ltd., Works: Darlington, County Durham



VIKING SPRINKLER FIRE PROTECTION

for any condition whatever it happens to be!

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the VIKING corporation

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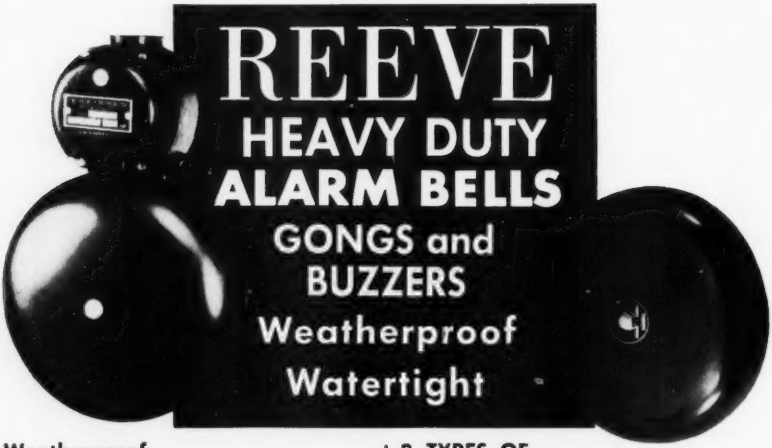


REEVE
HEAVY DUTY ALARM BELLS
GONGS and BUZZERS
Weatherproof
Watertight

Weatherproof —
Sizes 3", 4", 6", 8", 10", 12"
DC—6—220 V. · AC—12—220 V.

Watertight —
Sizes 3", 4", 6", 8", 10", 12"
DC—6—220 Volt · AC—12—220 Volt
60 Cycles, 110—220 Volt, 25 Cycles

3 TYPES OF
UNDERDOME BELLS
OPEN PIGTAIL • WEATHERPROOF • E-Z MOUNT
Sizes 6", 8", 10". Cast aluminum housing
Hot Pressed Steel Gong Shell
Single Stroke and Vibrating Types
Voltages are the same as Neck Type

Special Windings on request.

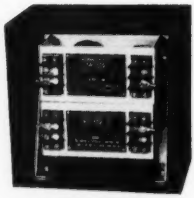
Seal of approval by UNDERWRITERS' LABORATORIES • FACTORY MUTUAL LABORATORY, INC. • UNITED STATES COAST GUARD

Write for Catalog Material and Prices!

AUTOMATIC BATTERY CHARGER, High and Low Current

The unit is designed for use on any storage batteries not subject to heavy drains. It will trickle charge the battery indefinitely because of its automatically decreasing rate of charge.

For use with six cells (12 volts). Automatically controlled by saturable reactor. Continuous output one ampere. 22.5 watts, 118 volts, 60 cycles. 3% Regulation. 9" x 9" x 6" — 14 B & S gauge steel wall cabinet. 15¼ lbs. U.L. Approved. No moving parts.



MODEL BC-12

Manufacturers of a complete line of
CENTRAL OFFICE and LOCAL FIRE ALARM DEVICES
• automatic alarm devices • sprinkler alarm and supervisory devices • burglar alarm devices and accessories. DYNALARM (sound detection for both reverberant and non-reverberant vaults).

THE REEVE ELECTRICAL CO., Inc.
120 West 42nd Street, New York 36, N.Y.

SEVERE TESTS* PROVE STARGARD SUPERIORITY

No sprinkler was ever subjected to more severe tests than the new "Stargard" Automatic Sprinkler.

* This is the third in a series of advertisements describing these tests conducted by the Underwriters' Laboratories, Inc.

☑ CORROSION
☑ ROUGH USAGE
☑ PAINT LOADING
☐ OVERALL STRENGTH

ROUGH-USAGE TEST #3

One sprinkler is subjected alone, then five sprinklers are subjected collectively to a Tumbling Barrel Treatment. The number of revolutions necessary to release the parts is a measurement of resistance to wear and tear.

After 20,000 revolutions the single sprinkler was found to be completely intact with sufficient tensile strength in the frame to forcibly release the operating parts when subjected to heat.

The test run continued to 50,000 revolutions. Parts of one sample released at 35,000. Upon testing the remaining four, all parts released promptly and effectively . . . proving that the Stargard has sufficient resistance to ordinary wear and tear likely to be found with sprinklers in service.

LISTED BY UNDERWRITERS' LABORATORIES, Inc.

APPROVED BY FACTORY MUTUAL LABORATORIES

For further particulars, write today.

STAR SPRINKLER CORPORATION

Westmoreland and Collins Sts. — Philadelphia 34, Pa.

Licensees in all Principal Cities of the United States and Canada

Nation Wide
Central Station Protection Services

Sprinkler Valve Alarm — Complete Sprinkler Supervisory — Manual Fire Alarm — Automatic Fire Alarm — Temperature Alarm — Oil Burner Supervision — Burglar Alarm — Hold-Up Alarm — Vault & Safe Protection

Available from these members of

Central Station Electrical Protection Association

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CHELSEA, MASS.	**CALL'S POLICE SIGNAL CORP.** **69 Washington Avenue**
CHICAGO, ILLINOIS	**CENTRAL WATCH SERVICE** **214 West Ohio Street**
CLEVELAND, OHIO	**MORSE SIGNAL DEVICES** **6707 Carnegie Avenue**
DALLAS, TEXAS	**SMITH DETECTIVE AGENCY & NIGHTWATCH SERVICE, INC.** **610 N. Akard Street**
DENVER, COLORADO	**DENVER BURGLAR ALARM COMPANY, INC.** **422-21st Street**
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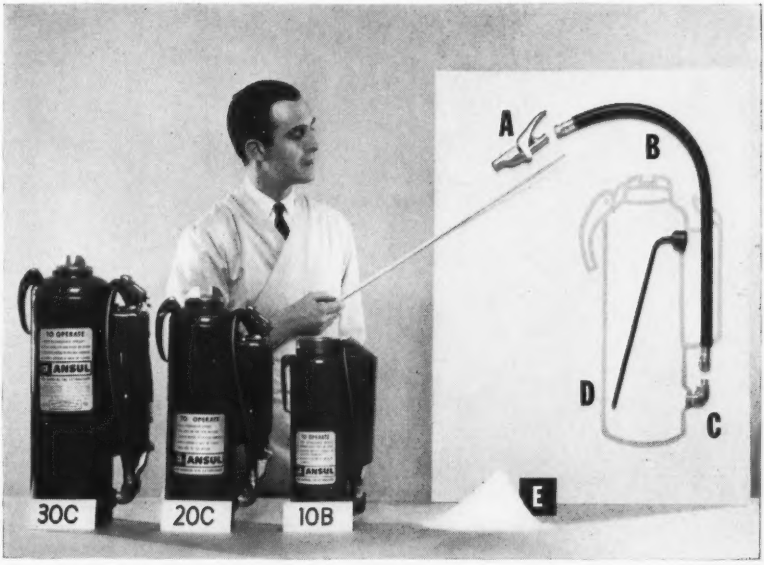
WASHINGTON, D. C.	**FEDERAL ENGINEERING CO., INC.** **1004 Sixth Street, N.W.**

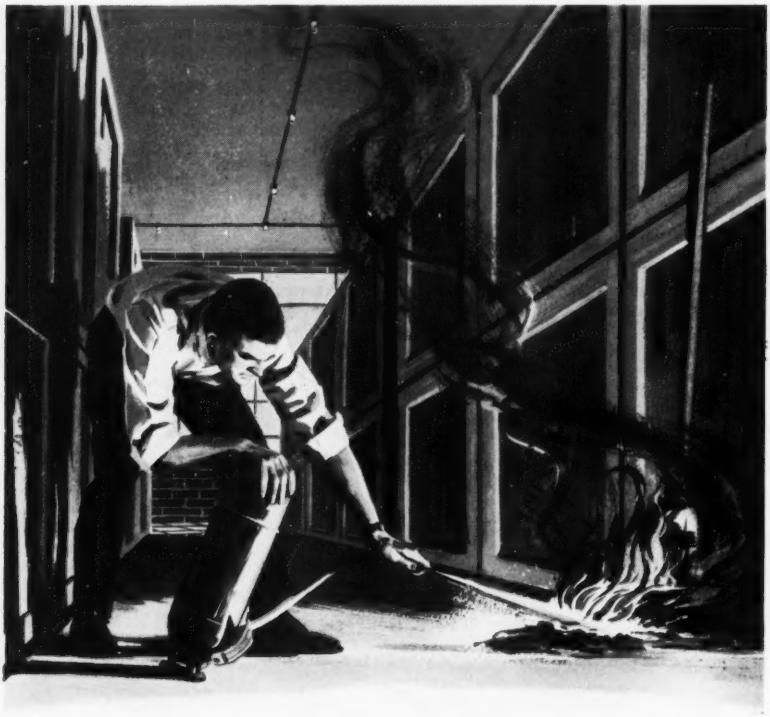


A Nozzle redesigned for more uniform fire coverage, faster fire put-outs. **B** Hose with larger diameter gets more dry chemical to fire faster. **C** Elbow enlarged to accelerate flow of dry chemical. **D** Gas tube redesigned for more uniform gas pressure distribution. **E** PLUS-FIFTY B dry chemical gives improved performance over a wider temperature range.

Important design improvements in these Ansul Extinguishers give you more fire fighting power at no increase in price. Three years of research and more than 2000 fire tests turned up some significant new information on dry chemical extinguishment. Ansul engineers were able to design these findings into three new extinguisher models, the 10B, 20C and 30C. Result, greatly increased fire fighting power. All Ansul equipment is backed by a five-year warranty. This is the best way we know to say Ansul fire extinguishers are the finest of their kind made anywhere.

The Ansul Chemical Co., Marinette, Wisconsin

ANSUL



NEW PYR-A-LARM DETECTS FIRE FASTER

MORE EFFECTIVELY THAN ANY OTHER SYSTEM

Here is a new proven fire detecting system that detects fire before it has the chance to really get under way . . . gives the Fire Department or employees the opportunity to fight the fire while it is still small.

Working on the nuclear energy principle, Pyr-A-Larm provides positive advanced warning through activation by the products of combustion rather than heat or other less effective methods.

Pyr-A-Larm is approved by both Underwriters' Laboratories, Inc. and Factory Mutual Laboratories and has already been recognized by hundreds of leading companies and government installations as the most modern, most effective means of fire detection.

For more specific information, write for our free booklet today!

Pyrotronics A DIVISION OF BAKER INDUSTRIES, INC.

NUCLEAR FIRE DETECTION AND ALARM SYSTEMS • P. O. BOX 390, NEWARK 1, NEW JERSEY

NOW... Kuhns ductile iron fittings

For Sprinkler Systems

Kuhns ductile iron pipe fittings—the newest development in piping—provide an extra margin of operating safety for sprinklers, high pressure lines and other vital piping systems. High structural strength and resistance to thermal shock help these fittings prevent leakage caused by vibration, temperature changes or misalignment.

"K" Pipe Lock Couplings

Listed for 800 psi by Underwriters' Laboratories, Inc., these couplings have a safety factor of five times the UL listing for 2½" through 6" and four times UL listing for 8". Sizes: 2½" through 8". Look for the "800 D" on each.

"K" Flanges and Flanged Fittings

Pressure rating, 500 psi by Underwriters' Laboratories, Inc. for elbows, base elbows, 45° elbows, side outlet elbows, tees, side outlet tees, and reducers in straight and reducing sizes. Flat faced flanges standard. Extra heavy flange dimensions and raised faces available. Look for the "DI 500" on each.

Complete range of sizes through 12".

"K" Screwed Fittings *

Pressure ratings listed by Underwriters' Laboratories, Inc.

STEAM AND OIL AT 550°F
¼" to 3".....300 lbs.

LIQUID AND GAS AT 150°F
¼" to 1".....2000 lbs.
1¼" to 2".....1500 lbs.
2½" to 3".....1000 lbs.

*Ductile iron fittings are available in any size in Kuhns complete cast iron line, ¼" through 12".

Note: These fittings are excellent for liquefied petroleum gas systems. Look for the "DI 300" on each.

Send for our catalog or contact your wholesaler.

THE KUHNS BROTHERS CO.
1800 McCALL STREET, DAYTON, OHIO

1887 • 70 Years of Continuous Progress • 1957

GLOBE
SAVEALL
DEVICES

FIFTY-FIVE YEARS' EXPERIENCE IN THE DESIGN, MANUFACTURE AND INSTALLATION OF ALL TYPES OF FIRE PROTECTION EQUIPMENT HAS RESULTED IN GLOBE PRODUCING THE MOST RELIABLE AND MODERN DEVICES.

Such experience includes complete automatic sprinkler installations, both wet and dry pipe type, deluge systems and special hazard systems involving fog, foam and CO_2 systems. The individual demand for devices can be met and supplied in the form of:

- SPRAY SPRINKLERS, BOTH UPRIGHT & PENDENT TYPE
- DRY PENDENT SPRINKLERS
- ORNAMENTAL FLUSH TYPE SPRINKLERS
- WINDOW & CORNICE SPRINKLERS
- SPRAY NOZZLES, AUTOMATIC & OPEN TYPE
- ALARM CHECK VALVES (MODEL E)
- DRY PIPE VALVES (MODEL F)
- AUTOMATIC AIR PRESSURE DEVICES (FOR DRY SYSTEMS)
- DETECTOR CHECK VALVES
- FUSIBLE LINKS
- UNDERWRITERS APPROVED FIRE HYDRANTS
- UNDERWRITERS APPROVED POST INDICATOR VALVES
- GATE VALVES & CHECK VALVES
- FIRE EXTINGUISHERS (ALL TYPES)
- ALMETL FIRE DOORS
- ALMETL HYDRANT HOUSES & HOSE CABINETS

Information furnished upon request.

GLOBE AUTOMATIC SPRINKLER COMPANY

2035 Washington Avenue PHILADELPHIA 46, PA.

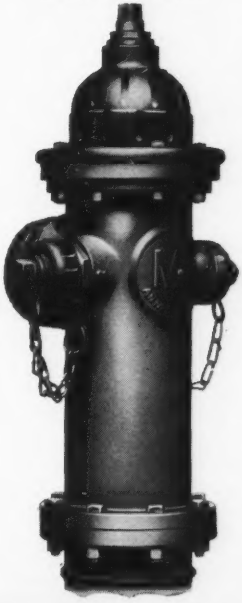
OFFICES IN PRINCIPAL CITIES

ALWAYS-READY GUARDIAN OF *LIFE AND PROPERTY*

MH

COMPRESSION TYPE FIRE HYDRANT

Above: Standard Model.
Below: Traffic Model.

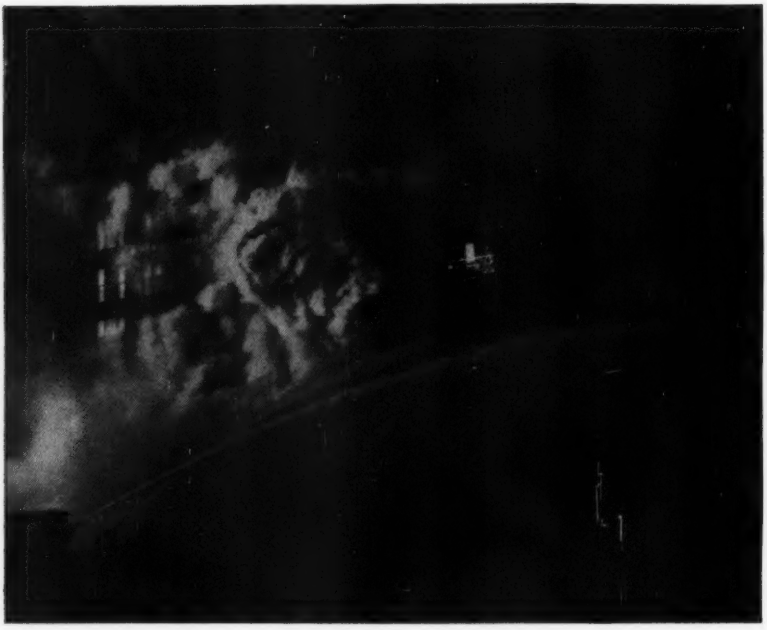


Although an M & H Fire Hydrant may stand idle for years, without a moment's notice it functions perfectly. Its simple rugged design and careful manufacture from highest quality materials is the reason.

Large diameter, unobstructed waterway gives high flow efficiency when large volume of water is needed to fight fire. All operating parts are bronze or bronze bushed. Furnished either in accordance with A. W. W. A. specifications or Underwriters and Factory Mutuals approved; also either standard model, traffic model or flush type. For complete information, address

M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA

SUBSIDIARY OF W WALWORTH



FACTS about FIRES and Fire PROTECTION systems

1 out of every 7

Each year, serious fire strikes one out of every seven manufacturing firms in this country. Lives are lost. Equipment, buildings and *records* are destroyed. Inventories are in ashes.

43 out of every 100

Out of every 100 of these firms that merely lose their records as a result of fire, *43 never open* for business again.

9 out of 10

And that is all so unnecessary... because in 9 cases out of 10 no investment is required by Blaw-Knox to install the most effective means of protection against fire loss... a Blaw-Knox *Automatic* Sprinkler System. And the system pays for itself in a few years by savings in reduced insurance premiums.

"Little Joey Sprinkler" always on the job

50th Anniversary BLAW-KNOX 1906-1936

BLAW-KNOX COMPANY

Automatic Sprinkler Department
829 Beaver Avenue, N. S., Pittsburgh 33, Pa.

VICTAULIC

METHOD OF PIPING

VICTAULIC COUPLINGS*

Styles 77, 77-D for standard applications. Simple, fast to install — sturdy and reliable. Sizes ¾" to 30". Style 75 Light-Weight Couplings for light-duty applications. Sizes 2" to 8". Additional styles for cast iron, plastic and other pipes. Sizes through 60".

ROUST-A-BOUT COUPLINGS *

Style 99 for plain or beveled end pipe. Best engineered, most useful plain end joint on the market. Simple, husky — easy and fast to install. Takes strong bull-dog grip on pipe. Sizes 2" to 12".

VICTAULIC FULL-FLOW FITTINGS

Complete line of Elbows, Tees, Reducers, Laterals, etc. — to fit all Victaulic Couplings. Streamlined for top efficiency, easy to install. Sizes ¾" to 12".

VIC-GROOVER TOOLS

Handy, on-the-job grooving tools that do the job in half the time. Light weight, easy to handle — operate manually or from any power drive. Automatic groove position and depth. Sizes ¾" to 8".

*APPROVED BY:

Underwriters' Laboratories, Inc.
Factory Mutual
New York City Board of Standards and Appeals, Cal. #413-53-SM.

Proven for 28 years on both wet and dry Fire Protection Systems. Standard with most major sprinkler companies for bulk-run and cut-in piping. Victaulic Couplings are installed in *less than one-half the time* required for other standard pipe joints.

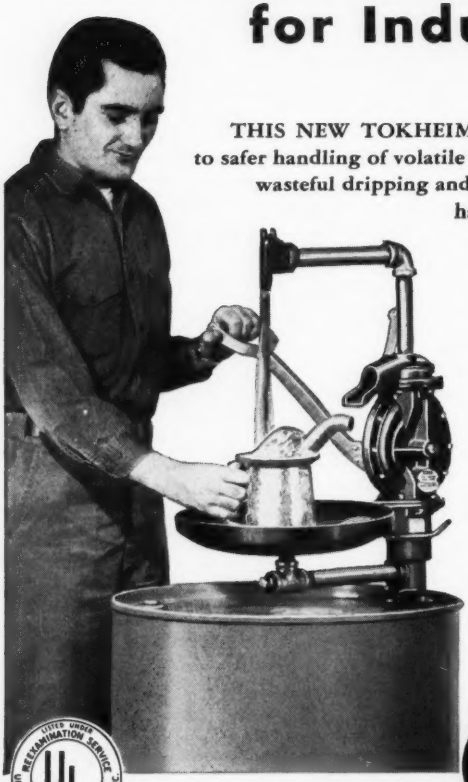
THE EASIEST WAY TO MAKE ENDS MEET

VICTAULIC

COMPANY OF AMERICA
P.O. Box 509, Elizabeth, N. J.

SAFER

liquid handling for Industry



THIS NEW TOKHEIM HAND PUMP contributes to safer handling of volatile liquids wherever used. Stops wasteful dripping and slippery floors. Reduces fire hazard and accidents common to other methods of liquid transfer. Approved for handling petroleum liquids —ideal for many others. Available in 22 different models for 'most any use— from pipe lines to drums, or underground tanks, with hose or spout outlets. Order from your dealer, your oil company, or your Tokheim representative.

Write factory for literature.

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QUALITY TOKHEIM HIGH VACUUM HAND PUMPS

General Products Division

TOKHEIM CORPORATION

DESIGNERS AND BUILDERS OF SUPERIOR EQUIPMENT

1686 Wabash Avenue *SINCE 1901* **Fort Wayne 1, Indiana**

Factory Branch: 1309 Howard St., San Francisco 3, California

Canadian Distributor: H. Reeder, 205 Yonge Street, Toronto

As industrial areas grow more crowded, the need for complete fire protection mounts. To the normal hazards in your own plant must be added those of new neighbors. Be sure that your flammable liquids are protected! Ask for specialized suggestions from National Foam.

NATIONAL FOAM System, Inc.
West Chester, Pa.

NATIONAL FOAM FIRE PROTECTION SYSTEM

The only company exclusively engaged in the design, development and manufacture of foam fire protection equipment and chemicals.

©

A piece of wire that might cause you disaster!

Defective or overloaded wiring is one major cause of industrial fires. Like all fires, they start small but grow rapidly—unless immediately stopped.

Call your local Pyrene-C-O-Two distributor today!

He carries a complete line of quality extinguishers, systems, brass goods, hose and accessories. Or write to:

Pyrene C-O-TWO

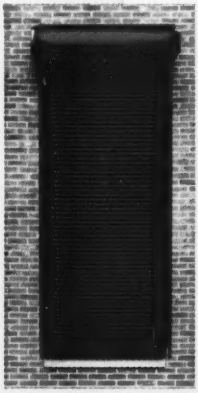
PYRENE-C-O-TWO DIVISION

THE FYR-FYTER COMPANY

Dept. NFPA Newark 1, New Jersey

BRANCHES IN ATLANTA • CHICAGO • DALLAS • DETROIT • SAN FRANCISCO

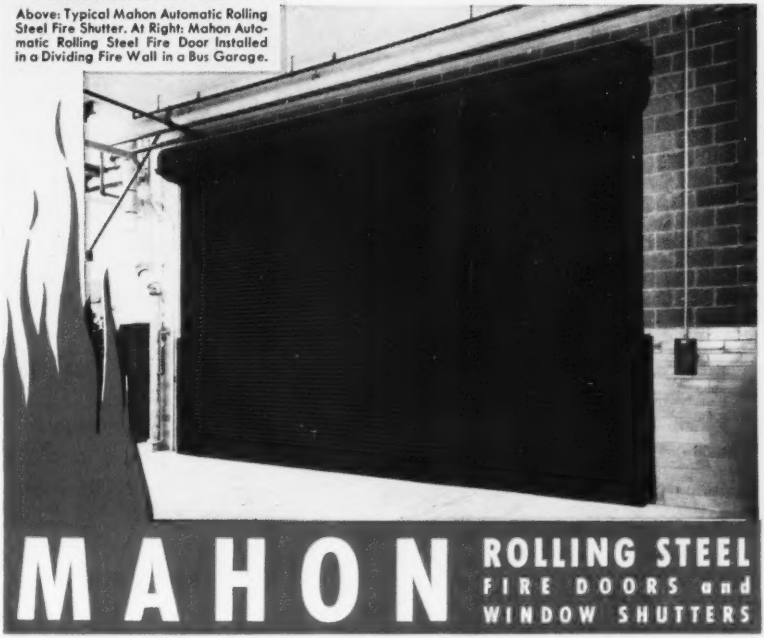
Automatic Rolling Steel
FIRE DOORS *and* WINDOW SHUTTERS PREVENT SPREAD *of* FIRE!



You need good automatic fire doors in fire walls, corridors, and vertical shafts . . . in some cases automatic rolling steel window shutters are necessary to protect your building and its contents from fires which may originate in nearby buildings. Many, many cases are on file which confirm that timely action of automatic rolling steel fire doors and window shutters have confined a fire to its point of origin and permitted its being extinguished with comparatively small damage. Make a survey of your building now, and don't delay action. You will find a Mahon Automatic Rolling Steel Fire Door or Window Shutter to meet each of your requirements—all bear the Underwriters' Label. These automatic fire doors may be operated manually or mechanically in every day use. If a fire should break out while they are in the open position, the automatic mechanism will close the door, cutting off drafts and preventing the spread of the fire. See Sweet's Files for complete information, or write for Catalog G-57.

THE R. C. MAHON COMPANY • Detroit 34, Michigan
Branch Offices in New York and Chicago • Representatives in Principal Cities
Manufacturers of Standard and Underwriters' Labeled Automatic Rolling Steel Fire Doors and Window Shutters; Underwriters' Rated Metalclad Fire Walls; Insulated Metal Curtain Walls; Electrified M-Floors; Steel Roof Deck; Acoustical Long Span M-Decks; and Acoustical and Troffer Forms.

Above: Typical Mahon Automatic Rolling Steel Fire Shutter. At Right: Mahon Automatic Rolling Steel Fire Door Installed in a Dividing Fire Wall in a Bus Garage.

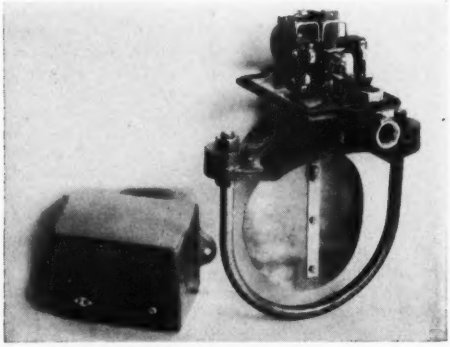


MAHON ROLLING STEEL FIRE DOORS and WINDOW SHUTTERS

CENTRAL STATION SIGNALS, INC.

Manufacturers of all kinds of approved devices used in Central Station Systems or Class 'A' or Class 'B' Proprietary Fire Alarm Systems, either automatic or manual.

53 WEST 23rd STREET . . . . . NEW YORK 10, N. Y.



Model PRS-1

Sprinkler

Waterflow Alarm

This device is approved by Factory Mutual Laboratories and Underwriters' Laboratories, Inc.

- This device is also made as Model PRT-1, a coded waterflow transmitter.

5-inch size shown above. To install simply drill 2-inch hole in pipe.

- Also made in explosion proof models.
- Made in all sizes from 2½" to 8".
- Has instantly recycling pneumatic retarding device, which prevents false alarms.
- Has enclosed electrical contacts for any voltage not exceeding 15 amp. 125 volts, A.C. and ½ amp. 125 volts, D.C. Operates on all water pressures or surges.

Tempo-Set Model A Fire Detector

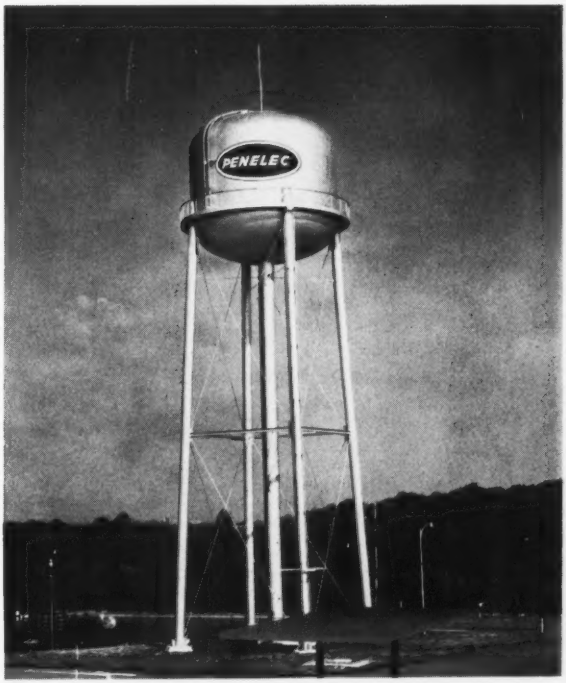
Underwriters' Laboratories, Inc. Approved.

- Self restoring and can be heat tested.
- Electrical contacts are silver or gold and are enclosed.
- Very reasonable price.

Size is 1⅝" x ⅝"

- Tempo-set Model A is approved in either open or closed circuit and the temperature ratings are 135 and 200 degrees.
- Approved spacing is 20' x 20'.
- Electric ratings are 125 volts 1 ampere, A.C. or 24 volts 0.5 ampere D.C. or less.

Chicago Bridge & Iron Company



Horton Tank Helps Realize $9,000 Insurance Saving

An insurance saving of approximately $9,000 a year is realized through the installation of a sprinkler system and a Horton ellipsoidal bottom elevated steel tank.

The sprinkler system protects the service wing of the $2,300,000 Service Center of Pennsylvania Electric Company, Erie, Pennsylvania. This Center serves a 1,762-square mile area and consolidates all company activities formerly conducted in six different locations.

The tank, 28 feet in diameter by 75 feet to the bottom capacity line, stores 100,000 gallons of water, of which 75,000 gallons are reserved for fire protection and the balance used for domestic service.

Offices

Atlanta
Birmingham
Boston
Chicago
Cleveland
Detroit
Houston
New Orleans
New York
Philadelphia
Pittsburgh
Salt Lake City
San Francisco
Seattle
South Pasadena
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Plants

Birmingham
Chicago
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IN CANADA:
Horton Steel Works Limited

RELIABLE SPRAY SPRINKLER

- Greater Coverage!
- Lower Ceiling Temperatures!
- Faster Cooling of Hot Fire Gasses!
- Better Fire Extinguishment with Less Water!
- Fewer Sprinklers Operating Adjacent to Fire Area!

Incorporating the new principle of water distribution, the Model "C" Spray Sprinkler is another example of Reliable's leadership in new product design. All Reliable Sprinkler Devices are the assurance of the ultimate in fire protection . . . and have been protecting life and property for over 30 years! Reliable Sprinkler Devices are distributed . . . installed and serviced by Reliable's chain of licensed representatives located throughout the United States, Canada and foreign countries. A Reliable representative is as near as your phone . . . Call him for a system designed to your specific needs!

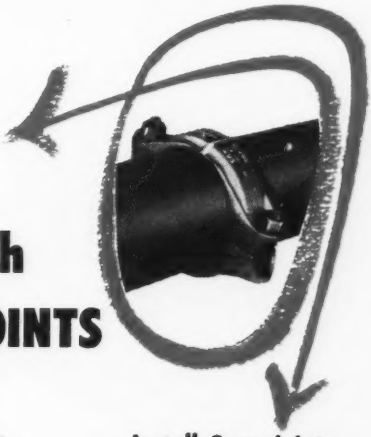
Constant Fire Protection That's Always "Reliable"!

THE R ELIABLE AUTOMATIC SPRINKLER CO. INC.

Manufactured and Distributed by

BRONX STREET, MOUNT VERNON, N. Y.

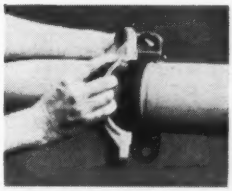
Couple Pipe the Easy, Low Cost Way with New G-B GRUVAJOINTS



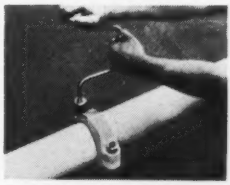
Now you can save up to 25% when connecting pipe for bulk runs and risers. Yes, contractors are saving money every day when they use new lightweight Gruvajoints. There's no flanging, no threading, no welding, and there's no need for heavy chain tongs or pipe wrenches. Gruvajoints are truly the modern way to couple pipe. Write today for free illustrated brochure on G-B Pipe Coupling Products. Gruvajoints are now available in 2", 2½", 3", 4", 5", 6" and 8" sizes.

Install Gruvajoints in three easy steps

Grease gasket and center over pipe ends.



Lay housing halves into grooves and insert bolts.



Tighten the two nuts equally.

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Underwriters' Laboratories, Inc.
File EX 1741A and B

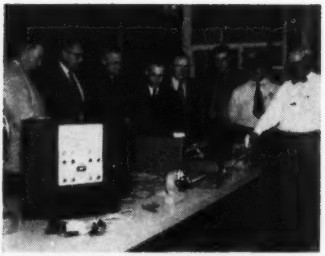
APPROVED by
Factory Mutual Engineering Division
Report Serial No. 13097

GUSTIN-BACON
manufacturing company
210 W. 10th St. Kansas City, Missouri

Technical Men seeking a challenge . . . ever think of MARKETING as an opportunity?

Step into new Fields with NOTIFIER

leading manufacturer of U.L. & F.M. listed automatic fire detection systems, sprinkler supervisory equipment, and municipal fire alarms.



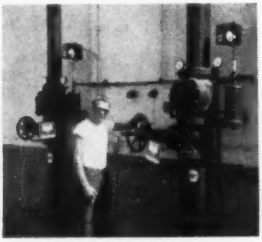
Demonstrating newest proprietary system to interested fire officials

A limited number of district **sales areas** are available to outstanding men of vision, organizing ability and technical competence who can build an alert, aggressive dealer organization. As a progressive manufacturer of quality alarm signaling equipment, NOTIFIER is anxious to complete its nationwide sales distribution.

Preparing to visit plant engineers

Or . . . attractive **dealer franchises** can be secured by men of character and integrity possessing a good sales and service record, or equal achievements, who would be happy operating a successful, independent fire alarm business.

The men selected are provided training in — local and national fire regulations, application of sound fire prevention and protection principles, marketing analysis, installation and servicing of **NOTIFIER** fire alarm equipment in industrial, institutional or municipal applications.



Inspecting and servicing a NOTIFIER system

Write for full details and send resume of experience to:

Field Sales Manager
NOTIFIER CORPORATION
Dept. K
239 South 11th Street
Lincoln 8, Nebraska

"AKBAR"

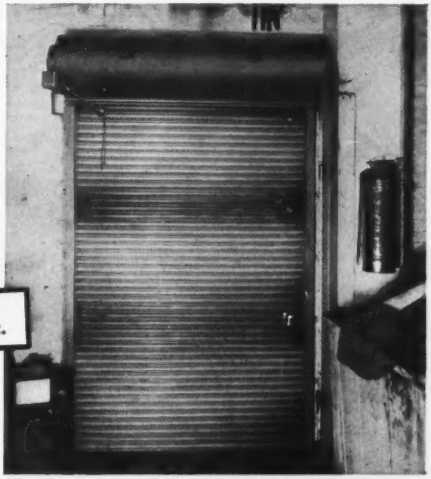
THE FAMOUS

KINNEAR

Steel Rolling

FIRE DOOR

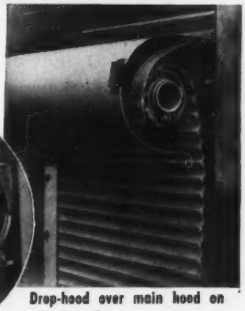
LABELED by Underwriters Laboratories, Inc.



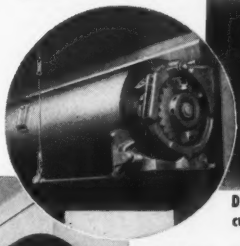
Akbar Fire Door just after confining a devastating fire to room on other side of fire wall. Note fire extinguisher still on wall.

Automatic positive-action Closure

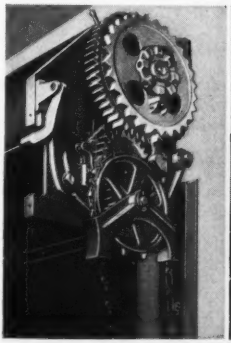
You get *positive, automatic* fire protection wherever openings are equipped with AKBAR Rolling Fire Doors (made *only* by Kinnear). The instant fire causes *automatic* release, they are *pushed* downward by a strong spring. Their closing speed is *controlled,* for safety. And they're operable *after* automatic release, for emergency exits.

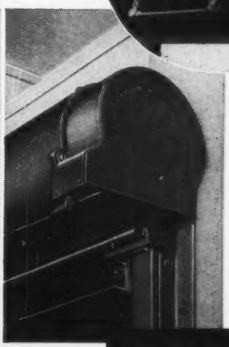


Drop-hood over main hood on curtain coil.



Right and below right: Manual Akbar operating mechanism. Below left: Mechanism of chain hoist "Akbar" Fire Door.





When closed, AKBAR Rolling Fire Doors block drafts, repel flames, keep fire from spreading. Kinnear Rolling Fire Doors can also be equipped for daily service, with motor or manual operation. (Use non-labeled Kinnear Rolling Doors where fire protection is not required.) Write for full details!

The KINNEAR Manufacturing Co.

Factories:
2250-70 Fields Ave., Columbus 16, Ohio
1742 Yosemite Ave., San Francisco 24, Calif.
Offices and Agents in All Principal Cities

KINNEAR
ROLLING DOORS
Saving Ways in Doorways

GRIMES

UPRIGHT
MODEL SSU

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Spray
SPRINKLERS

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MODEL SSP

FIRE SPRINKLER SYSTEMS AND EQUIPMENT

Engineered for better protection

ALARM VALVES
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SPRINKLERS — ALL TYPES AND FINISHES

NEW! MODEL "AB" GRIMES ACCELERATOR

Manufactured and Installed by

GRIMES DEVICES
ARE APPROVED BY
ALL INSURANCE
INTERESTS

RAISLER
SPRINKLER DIVISION

RAISLER CORPORATION, 129 Amsterdam Ave., New York 23
Licensees in all principal cities in the United States and Canada

GOODALL "EZ flex"
THE *Modern* FIRE HOSE

Stronger! Lighter! Longer Lengths!

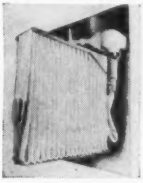
UL UNDERWRITERS *and* FACTORY MUTUAL APPROVED FM

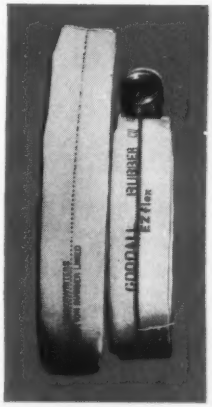
Greatest advance in fire hose construction in over half a century, incorporating new materials and methods of manufacture. Withstands highest pressures encountered in municipal and industrial plant fire fighting, with wide margin of safety.

JACKET — High-tensile fibres of outstanding strength woven by special process assuring highest resistance to pressure, wear, weather and rough handling. Pressure-resistance superior to heavier and stiffer conventional cotton jackets, despite much lighter weight. Tightly woven fabric is snagproof and treated to resist mildew.

LINING — Light-weight yet long-wearing reinforced rubber, bonded firmly to surrounding jacket. Smooth waterway insures full, fast flow. Combined, jacket and lining provide a fire hose far ahead of conventional types in strength, flexibility, ease of handling, and economy. Single Jacket, sizes 1½" to 2½". Double Jacket, sizes 1½" to 3". Maximum lengths of 100 ft.

"DRI-RACK" FIRE HOSE — Used in place of Unlined Linen Hose for indoor fire protection. Always ready for use after long storage. Light in weight and extremely flexible . . . folds into smaller space. No "weeping". Seamless, laminated, reinforced rubber lining. SINGLE JACKET, Sizes 1½" and 2½", Maximum length, 100'. *Underwriters and Factory Mutual Approved.*





COMPARE! *Above: Left —50 ft. coil of Standard Cotton Rubber Lined Fire Hose, weighing 21 lbs. Right, 100 ft. coil of Goodall "EZflex" weighing only 19 lbs.*

Standard of Quality—Since 1870

HOSE • BELTING • FOOTWEAR • CLOTHING
AND OTHER INDUSTRIAL RUBBER PRODUCTS

GOODALL *Rubber Company*

GENERAL OFFICES, MILLS and EXPORT DIVISION, TRENTON, N. J.

BRANCHES AND DISTRIBUTORS THROUGHOUT THE UNITED STATES.
IN CANADA: GOODALL RUBBER CO. OF CANADA LTD., TORONTO.

KEEP A KIDDE EXTINGUISHER NEAR EVERY HAZARD

Move fast against fire the instant it strikes, and you can stop it with little damage. But let it get a head start, and you may lose equipment, buildings . . . or your life.

Be selective in your choice of fire extinguishing equipment. Choose Kidde! You can be certain of rugged construction, simple operation, and absolute dependability.

For more than thirty years, Kidde fire extinguishers have been built to the most exacting specifications, have passed the most rigorous of tests, have the highest ratings. There is not a better-made extinguisher on the market today.

In ease of operation Kidde extinguishers also stand unsurpassed. The trigger-release grip on Kidde carbon dioxide and dry chemical extinguishers is the fastest and most natural to use. With it, even inexperienced operators can move swiftly and confidently against a blaze, extinguishing flames in seconds. You simply aim the horn, pull the trigger, and fire's out. Models with squeeze valves available too.

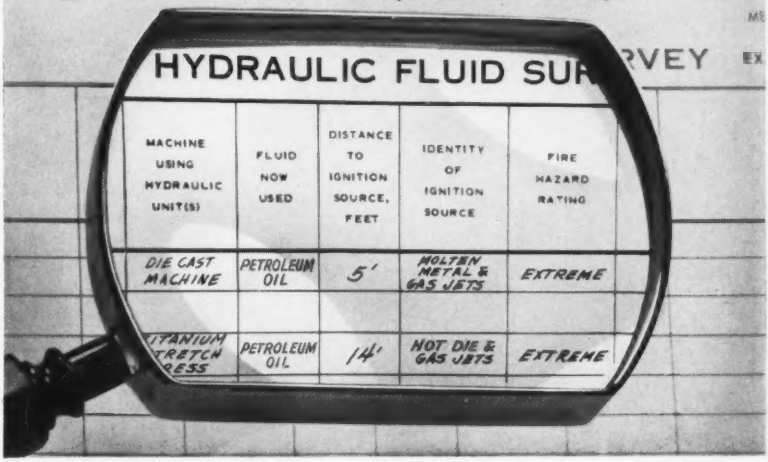
Finally, there is the Kidde service organization. In cities everywhere there are trained Kidde representatives who are ready to service your extinguishers.

For more information about the line of Kidde extinguishers, write for Kidde's P-8 Catalog.

Kidde

Walter Kidde & Company, Inc.
751 Main St., Belleville 9, N. J.
Walter Kidde & Company of Canada Ltd., Montreal—Toronto

Face the facts of hydraulic fluid fire dangers in your plant . . . it may shock you!



Write today for your free HYDRAULIC FLUID SURVEY SHEET

Monsanto's Hydraulic Fluid Survey sheet enables you to make an appraisal of the risk you take by using flammable hydraulic fluid in a machine near a source of heat. If you're shocked at the way you've been flirting with the possibility of a fire, switching to fire-resistant Pydraul F-9 hydraulic fluid will ease your mind. Send for your Survey sheet—today. It and Pydraul may save you from a staggering fire loss.

Pydraul: Reg. U. S. Pat. Off.

Pydraul F-9 is the first and only fire-resistant hydraulic fluid to be listed by Underwriters' Laboratories.

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MONSANTO

WHERE CREATIVE CHEMISTRY WORKS WONDERS FOR YOU

Organic Chemicals Division, Dept. I-74
MONSANTO CHEMICAL COMPANY
800 N. 12th Blvd., St. Louis 1, Missouri

Please send me ( ) free copies of the Hydraulic Fluid Survey sheet.

(Your name).....

(Company name).....

(Street).....

(City, state).....

New Design Sprays Water More Evenly Over Wider Area!

It's hard to improve on the best, but we've done it! By re-designing our already superior "Automatic" Spray Sprinkler, we have come up with a model that has an even *better* distribution pattern. We also made the casting more rugged. The resultant increase in efficiency means better performance in case of fire. While we were at it, we improved our sprinkler's appearance.

Available for upright or pendant installation.

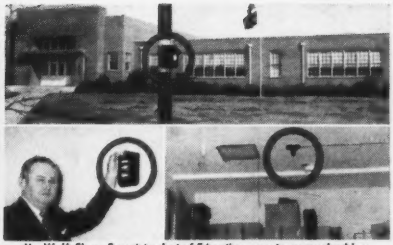
Ask your nearest "Automatic" Sprinkler fire safety engineer or write to us for complete information.

"AUTOMATIC" SPRINKLER CORPORATION OF AMERICA
YOUNGSTOWN, OHIO
OFFICES IN PRINCIPAL CITIES OF NORTH AND SOUTH AMERICA

"Automatic" Sprinkler

FIRST IN FIRE PROTECTION

All churches connect to Fire Department by Master boxes, like this one. Interior has Sprinkler Watchman, Detectors and Non-Code Stations.



Mr. W. H. Shaw, Superintendent of Education, reports every school has total 24-hour protection with directly connected fire alarm systems.

The main street has three Master boxes plus two more — all within 3 blocks.

Columbus Officials Design Total Fire Protection Using Modern Gamewell System

There are "no missing links" in Columbus, Georgia! Municipal management applies modern concepts in Fire Alarm Communications by using all the features of the Gamewell System to develop a completely integrated system which provides maximum protection for institutions, schools, churches, industrial properties, and commercial and public buildings. Over one-half of all the boxes in the city are Masters — directly connecting interior fire alarm systems to the Columbus Fire Department.

Direct Connection for Complete Protection is the theme in Columbus — why not make it yours, too? If you would like to develop this concept of fire alarm communications for your city, call on Gamewell. They offer a FREE Survey and technical assistance in helping you get the most for your money in Fire Alarms. Get started today—send for the "Quick Facts Checklist": **Conversation or Organization** . . . it will save you money.

FIRE FACTS **IN COLUMBUS:** Columbus fire protection is in the very able hands of this trio: Supt. of Alarm System, Tom Tillman; City Manager, J. A. Willman and Fire Chief T. C. Turner. They are shown in the new Police Headquarters and jail building which is protected by Detectors, non-code stations and alarm bell. Their responsibility covers a total of 27 square miles and a population of 135,000.

THE GAMEWELL COMPANY
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In Canada: Northern Electric Co., Ltd., Belleville, Ont.

FIRST WHEN SECONDS COUNT!

Manufacturers of precision electrical equipment since 1855

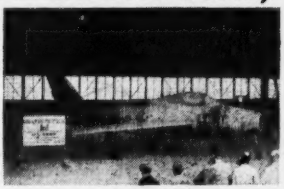
For Blanketing Fire in Chemicals, Gasoline, Oils

These pictures were taken at Robins Air Force Base in Georgia during tests of a Grinnell ProtectoFoam System. Above, a man slogs through foam to check the spray pattern produced by over 800 nozzles discharging 75,000 gallons of foam per minute.

With a ProtectoFoam system, a vapor tight blanket of foam floats on liquids and clings to solids, extinguishing flames and preventing re-ignition. It is particularly effective against fires in gasoline, oils, and chemicals.

The foam, a harmless mixture of water and a protein base foaming agent, is produced mechanically by special Grinnell nozzles. When the compound has been used up or shut off, these nozzles then discharge water similar to standard open sprinklers. Once the fire is out, the water discharge may be used to wash down the building and equipment and clean away the foam.

ProtectoFoam is only one of many Grinnell Fire Protection Systems designed for special hazard application. For unbiased advice on your fire protection problems, write to Grinnell Company, Inc., 274 West Exchange Street, Providence, Rhode Island.



Foam flows under aircraft to form a complete blanket.

Truck breasts hub-deep foam blanket outside hanger. Foam will dry out and disintegrate to a powder.

GRINNELL

WHENEVER FIRE PROTECTION IS INVOLVED

Manufacturing, Engineering, and Installation of Fire Protection Systems since 1870